Fol. 4/ ASSESS

Advisory Committee on Fishery Management ICES CM 1996/Assess:6

REPORT OF THE WORKING GROUP ON THE ASSESSMENT OF DEMERSAL STOCKS IN THE NORTH SEA AND SKAGERRAK

ICES Headquarters, Copenhagen, Denmark
2–10 October 1995

PART II

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK-1261 Copenhagen K Denmark

3.4 Whiting in Sub-area IV

3.4.1 Catch trends

Total nominal landings are given in Table 3.4.1 and total international catches as estimated by the Working Group in Table 3.4.2. Total international catches were 86,000 t in 1994, of which 42,000 t were human consumption landings, 33,000 t discards and 10,000 t industrial by-catch. This represents a continued decrease in total landings since 1990 (149,000 t). The 1994 human consumption landings were the lowest recorded since 1989 and the industrial by-catch is the lowest level recorded since 1962. The total landings of 52,000 t in 1994 were 69% of last year's *status quo* prediction (75,300 t) and close to half of the 1994 TAC of 100,000 t. Catch trends for the last 35 years are shown in Figure 3.4.1.

Whiting are caught for human consumption in the mixed demersal fisheries for Scotland (seine and light trawl) and England (seine and trawl). They are also caught incidentally in the Dutch and German trawl fisheries where the former may target whiting if cod are unavailable. French trawlers targeting saithe also take an incidental catch of whiting and, closer inshore, whiting may comprise a part of the French trawl mixed demersal fishery for vessels moving into the southern North Sea from the Channel. Whiting comprise a by-catch in the industrial fishery for Norway pout and clupeids.

3.4.2 Natural mortality, maturity, age compositions and mean weight at age

The natural mortality and maturity at age values as used are shown in Table 3.4.3.

The natural mortality values are rounded averages of the estimates produced by an earlier key run from MSVPA.

The maturity ogive is based on IYFS data averaged over the period 1981-1985.

Human consumption landings data and age compositions were provided by Scotland, the Netherlands, England and France. Discard data were provided by Scotland. Since 1991 the age composition of the Danish industrial by-catch has been directly sampled, whereas it was calculated from research vessel survey data during the period 1985-1990. Length distributions of the industrial by-catch from Norway were available and allocated to age by using the age composition of the Scottish discard age-length key.

Mean weights at age were available separately for the human consumption, discard and industrial by-catch components of the catch. Total international catch at age and mean weight at age in the catch are presented in Tables 3.4.4 and 3.4.5. The mean weights at age presented are not corrected for sum of products.

The catch mean weight at age was also used as the stock mean weight at age.

3.4.3 Catch, effort and research vessel data

Catch and effort data from commercial and survey vessels were used to tune the VPA. The fleets used in VPA tuning and the ages and number of years available for each fleet are listed in Table 3.4.6; their values are presented in Table 3.4.7. Data from the quarterly International Bottom Trawl Survey (IBTS) surveys for the second and fourth quarter have been included this year, at least in preliminary tuning runs. As final age-based data are not yet available for all the years for these surveys, the data for the second quarter comprise age-based indices from the Scottish component of the survey, while the fourth quarter values comprise age-based indices from the English component of the survey. IBTS data from the first quarter (formerly IYFS) have been treated as if the survey took place at the very end of the previous year, by adjusting the parameter values of alpha and beta in the tuning file and offsetting the index age by one year. This allows some survey data, collected after the most recent commercial catch at age data, to be used in tuning. The IBTS series for the first quarter are available for a longer period for ages 1 and 2 than for the older ages due to lack of proper sampling/ageing of the older age groups in the earlier part of the time series.

3.4.4 Catch at age analysis

The VPA was tuned using the XSA procedure. The basic parameter selections (pre-recruit age, catchability plateau etc.) were unchanged from last year, and based on the exploratory runs made then. The basic parameter selections and tuning options are shown in Table 3.4.8 and comprise a twenty-year tuning period with tricubic down-weighting of older data. The log-transformed catchabilities were considered to be independent of age at age six and older and ages younger than two were treated by recruit calibration within the XSA program

Although included in preliminary runs, the second and fourth quarter IBTS data series were excluded from the analysis because of their very limited time series (4 years). Their usefulness in assessments is discussed further in section 3.4.13. As at last year's meeting, the German groundfish survey (FRGGFS) and the Dutch groundfish series (NETGFS) were also excluded from the tuning based on the results of preliminary tuning runs. The Scottish groundfish survey (SCOGFS) was excluded from tuning at last year's meeting, but a preliminary tuning run this year gave no reason for continuing to exclude it. For this fleet, the negative residuals seen last year for all ages other than 0 in the two most recent data years are now absent from the residual plots.

The diagnostics of the final tuning run, including residuals for the excluded fleets, are given in Table 3.4.8. The log catchability residuals are shown in Figure 3.4.2.

The survivors estimates for ages 0 and 1 are dominated by the effects of shrinkage. In both cases over 20% of the final weighted value is derived from F-shrinkage in a recruit calibration model which should, arguably, comprise shrinkage solely to the population mean. The effect of including F-shrinkage for these age groups is to lower the weighted average prediction of survivors, but as the calculation of weighting factors is not immediately obvious, it was not possible to calculate the survivors values with the F-shrinkage component removed (the current version of the tuning program does not make it possible to select population shrinkage alone).

For ages 0 and 1, population shrinkage contributes 60% and 40% of the weighted prediction of survivors. At age two, the various survey series and French trawl and Scottish light trawl series contribute most to the estimate of survivors. Thereafter, up to age six, the commercial fleets contribute more, although the English and Scottish groundfish surveys continue to have some influence. After age 7, the estimates of terminal F are dominated by F shrinkage. Of the commercial fleets, French trawlers (FRATRB) contribute substantially to the weighted average prediction of most age groups, reflecting the relatively low scatter of residuals in the log-catchability plots.

The results of a retrospective analysis are shown in Figure 3.4.3. Based on the tuning options outlined above (SE of mean = 0.5 for shrinkage), the results indicate no retrospective pattern for mean F (all landings + discards) and, for the most recent years, consistent estimation although in earlier years of the series the estimates of terminal F were noisier. These results are in contrast to retrospective runs made at previous meetings, where stronger retrospective trends were apparent in mean F. However, there are indications of retrospective patterns in the estimates of recruitment and spawning biomass and these estimates are also noisy. Increasing the weighting given to the mean in shrinkage (SE of mean = 0.3) resulted in less of a retrospective pattern for recruits and spawning biomass, but more of a pattern for mean F. However, the use of stronger shrinkage also led to an extreme estimate of year class strength for 0-group in 1994 and noisier estimates of the recent spawning biomass. Because of this, the stronger shrinkage was disregarded and the default SE of the mean = 0.5 was accepted.

The fishing mortalities at age and stock numbers estimated from the final tuning run are presented in Tables 3.4.9 and 3.4.10.

There has previously been an inconsistency between survey-based estimates of year class strength used in predictions and tuned values for the same year classes estimated by the Working Group at its subsequent meeting. The tuned values have consistently been lower than RCT3 estimates suggesting that, according to the tuned results, the previous year's predictions will have been based on overestimates of year class strength. This inconsistency between survey data and commercial data is still apparent in the assessment. The current XSA results for the 1992 and 1993 year classes at age 1 are 2258 million and 2212 million respectively. The corresponding values from RCT3 estimated (but not used) at last year's meeting were 4243 million and 3408 million respectively.

3.4.5 Recruitment estimates

At last year's meeting, it was decided to incorporate all the XSA estimates of survivors into the input to catch prediction, including the estimates for recruiting year classes. Prior to that, RCT3 estimates of recruitment had been used to overwrite XSA tuned values for the youngest ages. This decision was made because of the inconsistency between RCT3 and XSA values outlined in the previous section. It was decided at this meeting to continue to use XSA estimates of survivors and not to use RCT3 estimates. However, as at the previous meeting, it is emphasised that the use solely of XSA survivors estimates does not mean that the Working Group believes these to be better estimates of recruitment than those produced by RCT3. It has made this decision for the sake of consistency of population estimates from year to year.

In principal, the RCT3 program and the recruit calibration procedure within XSA should operate in the same way (although the XSA implementation does not utilise index values which are more recent than the commercial catch data). In practice there are other major differences which may contribute to the inconsistencies described above. XSA forces F shrinkage on recruit population estimates as well as population shrinkage. If the former gets substantial weighting and estimates a low value for survivors from age 0, then it will artificially depress the XSA estimate of year class strength compared to the RCT3 estimate. However, the RCT3 estimate of year class strength also has problems in that it may get a double dose of population shrinkage, firstly during the XSA tuning run that is used to estimate VPA population abundance, and secondly, if default procedures are used, during the RCT3 recruit calibration.

The obvious way around these problems is to exclude F shrinkage from the recruit calibration procedure in subsequent versions of the XSA tuning package, as this would replicate more faithfully the RCT3 procedure.

At last year's meeting, the long term geometric mean abundance of 0-group was used for input to prediction as recruits in 1994 and onwards. However, using the long term mean in this way does not allow any account to be taken of temporal sequences of high or low recruitment. Figure 3.4.1 indicates that since 1979, recruitment has fluctuated around a lower level than in the preceding period. For this reason, the value for recruitment assumed in prediction for 1995 and subsequent years is the 20-year tapered geometric mean value (31,700 million) given in the XSA diagnostic output table (Table 3.4.8) rather than the long term geometric mean (41,864 million).

Scatterplots of research vessel survey indices against XSA estimates of 0-group numbers are shown in Figure 3.4.4. There is no clear correspondence of index against population estimate for those surveys with a reasonably long time series. This is consistent with similar plots made at the Roundfish Assessment Working Group in 1990 (Anon 1991). There was no time at this meeting to investigate the relationship between indices from different survey series or between commercial CPUE indices and survey series.

3.4.6 Historical stock trends

Long term trends in fishing mortality, recruitment and spawning biomass are given in Table 3.4.11 and plotted in Figure 3.4.1.

Fishing mortalities have been highly variable with no clear trend, although the human consumption landings component of F appears to have been stable since 1989. The 1994 year class is estimated to be the lowest since 1982, and estimates of all year classes since 1988 lie between 50% and 65% of the long term arithmetic mean (55%-75% of the long term geometric mean). The spawning stock biomass is estimated to have been stable since 1983, fluctuating around 270,000 t, relatively close to its lowest recorded value of 230,000 t and below the long term average of 370,000 t.

3.4.7 Biological reference points

The stock and recruitment plot is shown in Figure 3.4.5.

The following section gives prediction results for a variety of fishing mortality multipliers applied to the human consumption catches. These multipliers are not applied to the industrial by-catch component of the total catch as effort in the industrial fisheries is assumed to be constant in the restricted management scenarios referred to here. Although the industrial by-catch component of the total international catch is landed and included in the TAC for this stock, it is considered to be invariant with respect to the management options applied to the human consumption fishery. The biological reference points F_{high} *etc.* are, therefore, calculated in terms of reference F values in the human consumption fishery (landings + discards) and not to reference values applicable to the total international catch.

The *status quo* value of reference F in the human consumption fisheries is 0.65. The value of F_{med} corresponding to this is 0.8; F_{high} is > 1.6 and $F_{0.1}$ is 0.26. F_{max} is not defined. The equilibrium yield per recruit is shown in Figure 3.4.6 contingent on variation in reference F in the human consumption fishery.

3.4.8 Short-term forecast

Input data for short term catch predictions are given in Table 3.4.12.

The proportion of fish landed by the human consumption fleet compared to its catch in recent years does not show any consistent changes (*cf* North Sea haddock). Therefore, calculation of the partial Fs at age and mean weights at age in the various catch categories used in prediction continue to be averaged over a 5 year period.

Results of a *status quo* catch forecast are given in Tables 3.4.13 and 3.4.14 and Figure 3.4.7. The TAC for 1995 (81,000 t) is higher than the 65,000 t landings indicated by this prediction. This TAC appears unlikely to be taken and a TAC constrained prediction has not been made.

The prediction for the 1995 human consumption landings made at this meeting is 47,000 t compared to 55,200 t predicted last year, with 19,000 t of industrial by-catch forecast for 1995 compared to the prediction of 26,300 t made last year. Such year to year changes have previously been set against downwards revisions of year class estimates by XSA compared to values previously estimated by RCT3. However, RCT3 was not used in last year's prediction with the long term geometric mean being used instead. Given the apparent shift in recruitment levels over the last decade, this may have overestimated recruitment for input to prediction. The geometric mean used in prediction last year was 42,614 million for 0-group in 1994 compared to an XSA value estimated this year to be 23,495 million.

The spawning biomass at the start of 1996 was predicted last year to be 360,000 t at *status quo* F compared to the 250,000 t predicted this year for 1996. This revision is consistent with the reasoning set out in the previous paragraph; of the 1994 0-group, 92% of them will be considered mature as 2-year-olds in 1996 according to the ogive used in the assessment (Table 3.4.3).

A sensitivity analysis of the *status quo* forecast is presented in Table 3.4.13 and Figure 3.4.8-3.4.10. The estimates of human consumption landings in 1995 and 1996 are most sensitive to the overall level of fishing mortality in 1995, as well as to the population estimates, age-dependent selectivities and mean weights of the age groups contributing most to the human consumption landings. In addition, the human consumption landings in 1996 are also sensitive to the overall level of fishing mortality in 1996, the overall level of natural mortality in 1995 and the age-specific natural mortality values for the younger ages.

The estimate of spawning biomass at the start of 1996 is sensitive to the overall magnitude of natural mortality in 1995 and to the age-specific abundance and biological parameters of young fish, excluding the 1995 0-group. These sensitivities help explain why the downwards revision of the predicted spawning biomass in 1996 was made this year compared to last year's estimate. In particular, the estimate of the 1994 year class (N1 in the sensitivity analysis) has almost halved this year compared to last year.

The estimate of spawning biomass at the start of 1997 is sensitive to the recruitment estimates used in prediction and the estimates of weights and maturity at age of fish which are entering the spawning stock.

The sensitivities (Figure 3.4.8) are similar to those discussed in last year's report. However, the uncertainties in the prediction attributable to uncertainties in the input values (Figure 3.4.9) do differ from those reported last year for human consumption landings. This is due to changes made in the period over which the CV of the fishing mortality year-effect was calculated (Section 1.4.2).

Probability profiles for the human consumption landings in 1995 and 1996 and the spawning biomass in 1996 and 1997 are shown in Figure 3.4.10. They indicate an approximately 50% probability, at *status quo* human consumption F, that the spawning biomass at the start of either 1996 or 1997 will fall below its previously lowest recorded value of 230,000 t. This compares to a 26% probability estimated last year for the 1996 spawning biomass value. This difference is due largely to the downwards revision of the 1994 year class described above.

3.4.9 Medium-term projection

The inputs to medium term projection are similar to those for the sensitivity analysis. Because of the scatter of points on the stock and recruitment plot, the non-parametric approach chosen last year was selected again this year to generate recruitments in the medium term. The bootstrap approach that was chosen generates recruitments from the entire recruitment time series and does not account for temporal shifts in the overall magnitude of recruitment as indicated for whiting over the last decade. Because of this, the medium term prognoses presented here may overestimate yield and biomass values.

Three medium term projection scenarios were made, corresponding to *status quo* human consumption F and 30% deviations on either side of it. The results are presented in Figure 3.4.11. The projection program selected the same bootstrap series of recruitments in each case. In all cases, the spawning biomass would, on average, be expected to increase in the medium term. At higher levels of human consumption F, the increase is less marked and tends to a more constant value; the 5-percentile value remains below the lowest recorded value of spawning biomass at the end of the period. For the 30% reduction in human consumption F, the 5-percentile spawning biomass value rises above the lowest recorded value. In all cases the 5% - 95% inter-percentile range is very broad.

3.4.10 Long-term considerations

The present assessment indicates that the stock is stable in the medium term.

The *status quo* human consumption fishing mortality (0.65) is below F_{med} (0.8), calculated as outlined in section 3.4.7. Total mean F for ages 2-6 (human consumption landings + discards + industrial by-catch) is 0.72, also below F_{med}.

3.4.11 Comments on the assessment

The quality control charts are presented in Tables 3.4.15 and 3.4.16.

This assessment of this stock has been problematic in the past, with a tendency for RCT3 to overestimate year class strength relative to subsequent XSA estimates. However, despite XSA tuned values being used last year as inputs to prediction rather than RCT3 estimates, year class strength has again been revised downwards this year. This may be due to the use last year of the long term geometric mean value for recruitment after 1993; a procedure which does not account for the apparent temporal shift in the level of recruitment over the last decade. According to this assessment, both the predicted catch and spawning biomass were overestimated last year. This has been addressed this year for the short term prediction, but not for the medium term projections, by using a tapered mean value for recruitment after 1994.

The retrospective analysis made this year does not indicate a consistent pattern of over- or under-estimation for mean F, and, for the most recent years, the estimates of mean F are reasonably consistent (although this may mask age-specific changes in fishing mortalities which can cancel out in the average). However, the retrospective analysis does indicate a more obvious retrospective pattern in estimates of recruitment and spawning biomass; estimates which are also very noisy. This also indicates that retrospective plots made on the basis of mean F values alone, may give a mis-leading impression of whether retrospective patterns occur for other, important, stock indicators.

Previous meetings have concluded that the survey data and commercial catch data contain different signals concerning the stock, and that there remain inconsistencies in the annual international catch age distributions. It was not possible at this meeting to address either of these difficulties and they remain problematic to the assessment.

Discard data are available only for Scottish catches. Discards for other human consumption fleets are estimated by extrapolation from Scottish data, which account for nearly 70% of human consumption landings.

3.4.12 Evaluation of stock identity and stock unit used in assessment

Time did not allow this issue to be taken up.

3.4.13 Evaluation of the usefulness of quarterly International Bottom Trawl Surveys in the assessment

The new IBTS data series were excluded from the final XSA tuning this year because only 4 data points were available. However, results from a tuning run which included the new series are presented in Table 3.4.17. In addition plots of the new series' index values against the final run XSA abundance estimates are presented in Figure 3.4.12. It should be noted that the quarter 2 survey data relate solely to the Scottish component of the international survey, and the quarter 4 data relate solely to the English component. As and when survey data are fully worked up for the entire international data sets, then the various national components may be included as separate survey series, or presented as quarterly international series.

It can be seen from Table 3.4.17 that, for some age groups, the two new series, if included, would get considerable weighting in the final estimate of survivors. Notably 43% for survivors from age 0 estimated by the quarter 4 survey; 44% for survivors from age 1 estimated by the same survey; and around 20% each for both of the new series for survivors from age 2. Clearly, if the surveys maintained such a consistent series of log-catchability estimates over the longer term, they would heavily influence the assessment results.

The log-log plots of index against XSA abundance estimate (Figure 3.4.12) do not cover a wide enough range of index values, or population estimates, to indicate whether there is an underlying relationship. In general, survey data and XSA population estimates do not correlate well for North Sea whiting (Figure 3.4.4 and also Anon. (1991)).

Table 3.4.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1982-1994, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993[1]	1994
Belgium	2,272	2,864	2,798	2,177	2,275	1,404	1,984	1,271	1,040	913	1,030	944	1,042
Denmark	27,043	18,054	19,771	16,152	9,076	2,047	12,112	803	1,207	1,529	1,377	1,418	546
Faroe Islands	57	18	-	6	-	12	222	1	26	-	16	7	2
France	23,780	21,263	19,209	10,853	8,250	10,493	10,569	5,277[1,2]	4,951[1]	5,188[1,2]	5,115[1]	5,503[1,2]	5020[2]
Germany, Fed.Rep.	223	317	286	226	313	274	454	415	692	865	511	441[1]	239
Netherlands	12,218	10,935	8,767	6,973	13,741	8,542	5,087[3]	3,860	3,272[1]	4,028[1]	5,390	4,799	3,864
Norway	17	39	88	103	103	74	52	32	55	103	232	125[1]	80
Poland	-	1	2	-	-	-	-	-	-	-	-	-	-
Sweden	11	44	53	22	33	17	5	17	16	48	22	18	10
UK (Engl.& Wales)	4,743	4,366	5,017	5,024	3,805	4,485	4,007	1,896	2,124	2,423	2,691	2,769	2,723
UK (Isle of Man)	-	-	-	-	-	-	-	-	-	-	6	--	-
UK (N. Ireland)	-	-	-	-	-	-	1	61	30	47	9	3	+
UK (Scotland)	29,640	41,248	42,967	30,398	29,113	37,630	31,804	26,491	27,632	30,452	30,643	31,254	28,971
Total	100,004	99,149	99,958	71,934	66,709	64,978	66,294	40,124	41,046	46,596	47,042	47,281	42,497
Total h,c, catch used by Working Group	73,000	81,000	79,000	55,000	59,000	64,000	52,000	41,000	43,000	47,000	46,000	48,000	42,000

[1]Preliminary.
[2]Includes Division IIa (EC).
n/a = Not available.

TABLE 3.4.2 Whiting, North Sea
Annual weight and numbers caught, 1960 to 1994.

Year	Wt.('000 t)				Nos.(millions)			
	Total	H. con	Disc.	Ind. b	Total	H. con	Disc.	Ind. b
1960	180	48	122	11	1079	208	763	107
1961	325	68	241	16	2191	316	1646	229
1962	221	56	157	8	1526	242	1185	99
1963	258	58	154	45	1555	232	854	470
1964	147	60	59	28	944	239	341	364
1965	185	86	77	22	989	340	490	159
1966	240	105	84	51	1352	387	546	418
1967	234	68	143	23	1579	250	1103	227
1968	261	88	115	58	1622	301	754	566
1969	324	57	115	152	2730	204	626	1900
1970	268	79	74	115	2230	269	381	1580
1971	192	58	63	72	2158	178	458	1521
1972	188	60	67	61	1918	206	398	1314
1973	266	66	110	90	2200	239	659	1302
1974	290	75	85	130	2601	257	477	1867
1975	300	79	135	86	1983	261	699	1023
1976	361	75	136	150	2289	253	641	1395
1977	304	73	125	106	2469	265	547	1657
1978	179	88	35	55	1742	337	241	1163
1979	235	98	78	59	1882	350	645	887
1980	214	92	77	46	1427	311	471	644
1981	183	81	36	67	1408	261	214	932
1982	132	73	27	33	748	241	173	334
1983	154	81	50	24	1320	263	370	688
1984	138	79	41	19	923	252	326	345
1985	99	55	29	15	696	185	232	280
1986	156	59	79	18	1664	203	579	882
1987	134	64	54	16	929	228	416	285
1988	129	52	28	49	1378	195	232	951
1989	120	41	36	43	923	155	280	488
1990	149	43	55	51	1264	158	525	581
1991	119	47	34	38	1599	182	242	1175
1992	104	46	31	27	818	163	216	439
1993	111	48	43	20	1221	157	344	720
1994	86	42	33	10	697	137	234	326

TABLE 3.4.3 Whiting, North Sea
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
0	2.550	.000
1	.950	.110
2	.450	.920
3	.350	1.000
4	.300	1.000
5	.250	1.000
6	.250	1.000
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

TABLE 3.4.4___Whiting, North Sea
International catch at age ('000), Total , 1960 to 1994.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	60611	213989	75774	104418	231398	63412	84017	174929	100747	1162595
1	483058	1081961	1025371	543285	136615	342470	515035	970537	812634	362134
2	262911	629198	225149	752503	372569	148455	344517	213831	512647	1003771
3	219627	224307	160220	97750	166528	346549	93786	120530	108763	153285
4	21207	35086	32657	45933	23057	75052	265392	23233	47908	27714
5	24540	1404	6385	9518	10974	8372	38302	67325	7188	12703
6	3759	4395	293	1806	2797	3703	8484	7638	29919	1648
7	938	423	444	9	450	792	1542	824	1867	5682
8	2281	133	136	134	2	133	337	125	94	623
9	259	252	15	15	43	2	131	32	23	34
10+	8	21	0	1	14	10	0	3	5	1

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	1016520	1271128	538666	179323	577624	239879	424896	664579	686270	476847
1	531392	627724	919299	1170779	762097	958404	479032	1002274	417757	615315
2	79801	105629	320512	671363	986992	406888	1121905	475252	308833	460754
3	535588	17933	47553	133627	230159	302919	164515	271388	229269	205436
4	49607	119791	8052	18504	32150	56230	80533	29249	82902	91266
5	10958	12627	67942	5451	4775	9047	14401	20271	7176	27114
6	3546	2136	10012	18059	1180	7550	2768	5271	7215	3040
7	1160	673	4721	2480	5747	114	492	509	1818	1546
8	1256	161	270	362	343	1401	18	230	260	253
9	129	390	75	122	51	144	536	17	12	33
10+	16	25	938	53	21	2	29	159	14	5

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	332203	518592	101142	660386	181010	186791	488975	84835	416938	97197
1	265239	162310	189628	201396	336418	204024	762359	264023	426884	347896
2	411497	337750	104328	171829	168385	146134	165380	360447	299066	184564
3	272172	256595	232483	110046	112870	85250	177767	122418	177535	193395
4	84417	93800	85751	128775	47786	38050	47403	80510	39199	79464
5	49020	24474	25429	36293	59279	13843	14358	11104	15766	14563
6	10208	11022	6494	8609	13556	18255	3380	4288	1975	4658
7	1036	2823	2036	1733	2919	3183	3911	839	425	430
8	681	243	403	786	388	853	529	835	61	307
9	60	44	51	99	181	96	72	103	74	38
10+	20	38	31	34	21	10	1	7	38	6

Age	1990	1991	1992	1993	1994
0	285596	1042713	252094	625081	216702
1	248049	126494	218411	216312	157105
2	491359	184132	153497	163098	147402
3	123342	180839	83533	119030	92092
4	81858	34003	90362	44796	46376
5	31088	24746	10852	45912	17627
6	1909	5376	6288	3981	17757
7	641	574	2612	1562	1179
8	89	261	102	708	429
9	16	2	7	63	72
10+	0	1	1	16	0

TABLE 3.4.5 Whiting, North Sea
International mean weight at age (kg), Total catch, 1960 to 1994.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.058	.042	.055	.050	.042	.058	.073	.062	.038	.043
1	.117	.119	.119	.113	.123	.124	.109	.118	.113	.097
2	.191	.193	.187	.195	.174	.205	.188	.198	.187	.172
3	.260	.258	.263	.270	.262	.239	.258	.266	.289	.258
4	.338	.303	.329	.348	.344	.321	.291	.328	.346	.348
5	.349	.412	.393	.404	.425	.408	.381	.339	.464	.397
6	.400	.415	.511	.465	.469	.483	.467	.425	.452	.395
7	.517	.492	.518	.822	.536	.518	.487	.479	.593	.536
8	.448	.385	.540	.625	.601	.635	.733	.626	.727	.669
9	.383	.468	.590	.497	.766	1.256	.744	.621	.780	.729
10+	.398	.475	.000	.610	.694	.613	.000	.486	.842	1.236

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.020	.036	.022	.027	.026	.030	.019	.018	.010	.009
1	.111	.115	.072	.083	.070	.100	.106	.073	.074	.098
2	.203	.214	.198	.165	.148	.214	.193	.155	.179	.165
3	.239	.274	.277	.271	.251	.275	.293	.264	.235	.256
4	.351	.311	.385	.374	.366	.383	.349	.370	.327	.304
5	.457	.427	.419	.460	.449	.487	.446	.428	.433	.419
6	.423	.517	.525	.464	.494	.497	.524	.460	.437	.455
7	.518	.609	.573	.555	.540	.912	.534	.559	.476	.503
8	.621	.512	.726	.754	.754	.604	.570	.446	.617	.588
9	.747	.727	.778	.840	1.009	.736	.738	.736	.704	.623
10+	.803	.728	.816	.868	.969	1.022	.892	.507	1.266	.563

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.013	.011	.029	.014	.020	.014	.014	.012	.013	.023
1	.075	.082	.060	.106	.086	.094	.092	.076	.054	.068
2	.176	.166	.183	.190	.188	.187	.181	.147	.144	.155
3	.253	.241	.252	.276	.274	.265	.253	.247	.223	.224
4	.332	.327	.314	.328	.338	.324	.321	.300	.298	.265
5	.341	.396	.378	.389	.383	.391	.382	.374	.337	.316
6	.469	.424	.482	.435	.392	.429	.461	.374	.414	.385
7	.484	.474	.506	.467	.462	.469	.464	.492	.432	.435
8	.574	.651	.704	.532	.580	.423	.524	.458	.834	.347
9	.539	.845	.784	.674	.510	.498	1.186	.854	.588	.511
10+	.808	1.032	1.102	.503	.863	.789	.529	.602	.642	.827

Age	1990	1991	1992	1993	1994
0	.015	.017	.012	.012	.013
1	.081	.101	.082	.070	.075
2	.136	.162	.179	.169	.164
3	.208	.212	.247	.241	.249
4	.249	.275	.273	.309	.315
5	.277	.295	.321	.327	.375
6	.409	.332	.337	.342	.375
7	.494	.357	.311	.396	.415
8	.633	.385	.482	.372	.436
9	.350	.496	.773	.406	.390
10+	.000	1.058	1.728	.353	.000

Table 3.4.6 North Sea whiting. Fleets available for VPA tuning. NETGFS, FRGGFS, IBTS_Q2_SCO and IBTS_Q4 were not used. SCOGFS was reinstated after being excluded last year.

Country	Fleet	Code	Initial Year	Age Range
Scotland	Groundfish survey	SCOGFS	1982	0-6
	Seiners	SCOSEI	1975	1-9
	Light trawlers	SCOLTR	1975	0-9
Netherlands	Groundfish survey	NETGFS	1980	0-3
England	Groundfish survey	ENGGFS	1977	0-6
France	Trawlers	FRATRB	1976	0-9
Germany	Groundfish survey	FRGGFS	1983	1-6
International	Groundfish survey	INTGFS	1973	0-5
	Q II survey[1]	IBTS_Q2_SCO	1991	1-6
	Q IV survey	IBTS_Q4	1991	0-1

[1] Scottish sub-set of data

Table 3.4.7 NORTH SEA WHITING : 1960-1994

SCOSEI

```
    1975    1994
       1       1    .000   1.000
       1       9
 329432.000  54582.633  32133.371  42286.102  11065.222    921.781    113.705     20.975    322.348     37.534
 307165.000  22230.104  69024.820  13136.200  11560.430   2015.027    281.492     45.849       .000     77.837
 313913.000  22348.506  51524.219  38559.492   3508.061   2663.805    391.473     32.711     10.552      1.055
 325246.000  15280.865  30303.391  46131.969  16283.830   1126.218   1499.850    213.960     38.321       .000
 316419.000  90801.672  41680.648  28869.990  15176.030   6258.471    697.257    160.431      3.085       .000
 297227.000  27051.857  74336.844  38957.680  12545.560   9843.901   2697.567    274.548    241.814     28.511
 289672.000   8727.029  22244.584  25049.320  10552.758   2402.173   2084.163    374.029     41.003      4.000
 297730.000   3760.845   7159.982  26980.301  13595.560   2826.843    561.447    289.486     84.718      5.230
 333168.000  11621.000  15212.000  22230.000  35421.000  10215.000   2249.000    425.000    165.000     17.000
 388035.000   4924.000  24064.000  20786.000  15096.000  21428.000   4750.000    967.000     88.000     50.000
 381647.000  20066.000  20313.000  19789.000   9005.000   4824.000   8061.000   1371.000    336.000     18.000
 425017.000 138647.000  47997.000  33606.000  10969.000   2534.000   1058.000   1706.000    208.000      7.000
 418536.000  13784.000  52788.000  39145.000  18551.000   3663.000   1105.000    300.000    351.000     16.000
 377132.000   2501.000  28440.000  44875.000  12635.000   4073.000    679.000     64.000     21.000     17.000
 355735.000   6870.731  15630.461  41154.742  23525.039   4725.091   1308.520    110.865     42.648     10.603
 252732.000  13621.970 118993.500  26173.480  28126.801  13926.352    673.570    193.567     21.588       .016
 336675.000  11926.922  44593.961  62140.871  10172.594   8465.397   1686.039    189.748     90.510       .000
 300217.000  16629.938  19320.043  20784.031  27282.256   2732.422   1904.943    550.611     31.491      3.289
 268413.000   9569.599  31528.064  25624.680  12160.299  14110.971    877.112    323.664    148.438      7.280
 264738.000   9238.238  21307.570  22225.840  11499.070   5393.488   5460.241    198.107    112.451     14.268
```

SCOLTR

```
    1975    1994
       1       1    .000   1.000
       0       9
 161009.000      4.000  26628.199  13999.750  20259.240   3972.133    490.619     39.342      5.786    215.225     24.300
 152419.000     29.000   5608.160  30813.910   5567.744   5542.412    930.234    207.086     19.116      1.062     46.727
 224824.000    709.000  24703.080  30877.230  26163.619   1759.456   2569.652    489.871     36.208     19.169       .000
 236944.000   7158.000   8930.432  21071.371  33819.867  16068.990   1070.808   1805.589    711.259     80.647      6.721
 287494.000    368.000 171183.031  43537.230  23786.850  18557.359   4185.145    389.185    295.179     58.842      5.162
 333197.000    869.000  20821.664  58806.258  39453.781   9870.979   9734.453   1939.122    149.828    150.869      3.121
 251504.000    171.000   6577.000  19070.000  21550.000   9706.000   1777.000   1455.000    310.000      9.000      1.000
 250870.000   6390.000   5221.679   8269.732  27044.900  13131.583   3385.107    658.538    345.724     75.472     16.318
 244349.000  20095.711  37321.211  17868.980  12523.255  19240.107   6126.091   1217.946    182.988    140.988     26.000
 240775.000   2541.000  38082.000  15948.000  10695.000   6249.000   8936.000   2349.000    474.000     13.000     30.000
 267393.000   1218.000  28679.000   9406.000   7683.000   3117.000   1347.000   2932.000    448.000    175.000     14.000
 279727.000    794.000   8100.000   8503.000   9485.000   4063.000    758.000    420.000    601.000     51.000      2.000
 351131.000    600.000  18786.000  26106.000  16372.000   6046.000   1202.000    395.000    118.000    131.000      4.000
 391988.000     60.000   2398.000  15774.000  22509.000   5123.000   1639.000    207.000     31.000     15.000      6.000
 405883.000    492.409  20345.871  10096.233  21518.320  10927.107   2415.639    453.172     33.442     54.961      2.414
 371493.000    355.510   3518.714  33795.102   7328.675   8566.872   3272.489    152.520     38.175      5.104       .064
 408056.000    688.936   8711.826  11803.481  21682.646   3100.801   2817.552    608.402     48.552     39.543       .433
 473955.000   1377.705  17542.492  14403.111  11572.477  15037.751   1463.070   1128.928    297.240     12.397       .332
 447064.000    613.941  16415.133  20374.498  14124.279   6405.780   9826.469    556.376    196.717     94.019     23.528
 480400.000   1259.768   4128.249  15656.981  12780.158   6312.874   2645.398   2923.650    167.457     81.763     13.505
```

FRATRB

```
    1976    1994
       1       1    .000   1.000
       0       9
  64396.000   2718.176  12660.400  45922.730   6144.021   4686.502   1283.520    254.502     42.000      3.000    156.000
  80107.000   2587.217  24164.770  21839.020  17682.973   1796.618   2279.117    554.182     54.000     31.000      6.000
  69739.000   3351.619   7329.894  23791.080  19206.982   9382.724    836.851   1103.903    227.000     34.000      4.000
  89974.000    591.577  61934.949  28649.650  18463.107  11830.262   3952.164    397.490    315.873     45.000     14.000
  63577.000    271.805   9010.907  27061.609  18939.109   5826.750   4984.128   1071.911     78.000     71.000     10.000
  76517.000    107.483   6395.208  18559.809  20258.025   9102.931   2249.317   1662.444    315.272     16.000     10.000
  78523.000   2984.330   8779.621   5953.567  24942.854  14159.822   4423.814   1089.917    542.530    119.000     14.000
  69720.000   9847.176  21650.891  16248.500  12814.012  19952.447   6138.934   1102.000    231.451    127.293     19.000
  76149.000   1565.244  19118.779  12032.536   9042.073   4992.344   6420.571   1692.968    322.167     32.000     26.000
  53003.000    569.315  10538.630   7125.292   5882.456   2466.352   1082.094   1285.727    233.335     34.000     10.000
  50350.000    469.844  24185.590  10476.063   8141.797   2748.000    695.045    237.376    238.742     54.704      3.000
  51234.000    559.765   9281.398  14857.700   6589.579   3721.511    708.581    209.755     76.000     82.710     10.000
  35482.000   1030.389   3151.860   5865.833   7552.072   1901.517    843.631    160.790     42.000      7.158      7.000
  36133.000    400.274   8777.309   3328.653   8279.287   3991.235    756.156    229.588     22.130     17.156      1.147
  36097.000   7628.034   4106.208  14999.269   4149.499   3876.452   1574.084     90.705     34.860      2.702       .128
  45075.000    296.468   3603.230   5310.162   7751.244   1263.257    971.242    211.707     33.271      4.032       .317
  34138.000    318.082   4710.102   3988.976   3305.709   4310.230    420.811    274.886    141.965      2.076       .137
  23721.000   2141.261   5620.430   5222.737   4707.011   1886.444   2272.423    160.641     75.760     20.939      4.889
  17316.000    373.301   3619.637   6214.334   3590.832   1987.115    551.314    566.055     30.460     10.456      1.446
```

SCOGFS

```
1982    1994
1       1       0.5     0.75
0       6
100     1.02    6.53    9.71    9.72    2.24    0.6     0.16
100     2.100   5.630   5.780   4.070   5.110   1.160   0.170
100     4.420   10.480  3.710   1.700   0.770   0.920   0.180
100     1.690   15.770  9.730   2.470   0.630   0.360   0.180
100     4.060   11.110  4.520   2.240   0.270   0.050   0.050
100     1.200   14.050  11.500  2.080   0.770   0.160   0.030
100     6.420   9.670   16.060  4.520   0.700   0.190   0.020
100     4.270   40.430  7.410   7.330   1.570   0.130   0.060
100     19.430  22.390  20.530  2.480   2.550   0.470   0.050
100     13.790  17.690  9.500   7.590   0.510   0.400   0.090
100     24.170  29.250  12.670  5.530   5.850   0.470   0.260
100     2.470   31.690  11.680  4.230   1.560   1.820   0.060
100     6.480   26.350  9.500   2.540   0.570   0.340   0.230
```

E:\ACFM\WGNSSK96\WHG_NSEA\T347.REP 27/10/95 14:35

Table 3.4.7 Continued

```
NGGFS
1977    1994
1       1       0.5     0.75
0       6
100     28.428  21.953  7.441   1.109   0.216   0.091   0.080
100     18.441  24.714  5.151   1.055   0.345   0.051   0.022
100     35.476  20.064  7.117   1.899   0.843   0.057   0.029
100     19.903  35.327  12.508  4.810   1.205   0.314   0.058
100     34.942  18.314  28.804  16.052  0.618   0.616   0.080
100     6.932   27.722  7.934   8.590   2.220   0.340   0.049
100     71.673  11.853  10.803  1.906   1.696   0.242   0.067
100     17.252  50.613  10.818  3.012   0.889   0.769   0.378
100     19.990  15.878  17.043  1.673   0.981   0.182   0.153
100     16.334  15.162  6.592   3.847   0.406   0.104   0.014
100     13.731  22.763  13.036  2.687   2.009   0.352   0.118
100     38.169  18.806  13.160  4.546   0.645   0.174   0.018
100     116.948 29.474  11.760  7.694   1.674   0.345   0.019
100     87.532  19.009  12.836  3.854   2.318   0.325   0.046
100     16.732  33.304  7.665   3.818   1.086   0.371   0.042
100     45.505  26.555  13.070  3.046   2.610   0.493   0.589
100     25.243  25.104  9.629   3.750   1.161   0.742   0.188
100     21.143  30.546  10.594  2.439   1.124   0.333   0.114

INTGFS
1973    1994
1       1       0.99    1
0       5
1       0.322   0.496   -1      -1      -1      -1
1       0.893   0.153   -1      -1      -1      -1
1       0.679   0.535   -1      -1      -1      -1
1       0.418   0.219   -1      -1      -1      -1
1       0.513   0.293   -1      -1      -1      -1
1       0.457   0.183   -1      -1      -1      -1
1       0.692   0.391   -1      -1      -1      -1
1       0.227   0.485   -1      -1      -1      -1
1       0.161   0.232   -1      -1      -1      -1
1       0.128   0.126   0.113   0.079   0.033   0.006
1       0.436   0.179   0.091   0.031   0.026   0.011
1       0.341   0.359   0.066   0.019   0.007   0.007
1       0.456   0.261   0.198   0.033   0.007   0.004
1       0.669   0.544   0.09    0.046   0.005   0.002
1       0.394   0.862   0.315   0.034   0.012   0.001
1       1.465   0.542   0.421   0.112   0.012   0.005
1       0.509   0.887   0.202   0.093   0.017   0.004
1       1.014   0.675   0.482   0.071   0.038   0.008
1       0.916   0.748   0.261   0.169   0.016   0.014
1       1.087   0.524   0.245   0.066   0.059   0.012
1       0.721   0.637   0.18    0.067   0.012   0.009
1       0.679   0.457   0.245   0.059   0.012   0.006

NETGFS
1980    1994
1       1       0.5     0.75
0       3
100     16.6    33.0    6.2     2.7
100     139.3   20.5    13.1    0.9
100     16.6    64.0    10.5    5.2
100     264.9   43.1    22.4    1.2
100     14.3    133.0   14.1    9.1
100     85.9    78.3    89.3    3.2
100     178.4   38.4    7.5     17.0
100     288.3   200.4   25.2    1.8
100     62.9    144.1   61.2    2.5
100     188.2   104.9   80.3    21.2
100     554.3   96.3    19.6    15.4
100     80.6    155.2   21.4    1.9
100     45.3    27.2    31.0    4.0
100     265.5   34.0    6.1     5.0
100     179.5   66.0    35.3    24.7

FRGGFS
1983    1994
1       1       0.25    0.5
1       6
100     0.68    1.53    0.92    0.90    0.23    0.03
100     0.57    1.29    1.05    0.32    0.35    0.08
100     0.96    2.28    0.74    0.18    0.09    0.06
100     1.22    2.46    1.92    0.31    0.09    0.05
100     9.10    7.08    1.88    1.70    0.15    0.04
100     1.51    7.98    4.09    0.53    0.32    0.02
100     60.31   39.23   14.46   5.41    0.43    0.14
100     28.02   24.85   8.60    3.23    2.02    0.39
100     32.43   16.37   11.65   3.71    1.07    1.32
100     12.07   7.33    5.66    3.31    0.78    0.32
100     -1      -1      -1      -1      -1      -1
100     18.18   7.90    2.65    0.88    0.33    0.08
```

Table 3.4.7 Continued

```
IBTS_Q2_SCO
1991    1994
1       1       0.25    0.5
1       6
100     94.90   38.56   22.86   3.74    1.23    0.51
100     129.76  47.50   11.42   4.28    1.14    0.45
100     104.67  41.49   20.86   5.17    4.85    0.36
100     65.40   35.71   8.55    2.38    0.90    0.75

IBTS_Q4
1991    1994
1       1       0.75    1
0       1
100     76.100  85.300
100     121.931 62.509
100     132.638 80.677
100     143.100 118.430
```

Table 3.4.8

Lowestoft VPA Version 3.1

4/10/1995 13:22

Extended Survivors Analysis

NORTH SEA WHITING : 1960-1994 : 30/8/95

CPUE data from file WHIIVEF.TUN

Catch data for 35 years. 1960 to 1994. Ages 0 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
SCOSEI	1975,	1994,	1,	9,	.000,	1.000
SCOLTR	1975,	1994,	0,	9,	.000,	1.000
FRATRB	1976,	1994,	0,	9,	.000,	1.000
SCOGFS	1982,	1994,	0,	6,	.500,	.750
ENGGFS	1977,	1994,	0,	6,	.500,	.750
INTGFS	1973,	1994,	0,	5,	.990,	1.000
NETGFS	1980,	1994,	0,	3,	.500,	.750
FRGGFS	1983,	1994,	1,	6,	.250,	.500
IBTS_Q2_SCO	1991,	1994,	1,	6,	.250,	.500
IBTS_Q4	1991,	1994,	0,	1,	.750,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

Catchability independent of age for ages >= 6

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting applied :

Fleet	Weight
SCOSEI	1.00
SCOLTR	1.00
FRATRB	1.00
SCOGFS	1.00
ENGGFS	1.00
INTGFS	1.00
NETGFS	.00
FRGGFS	.00
IBTS_Q2_	.00
IBTS_Q4	.00

Tuning converged after 21 iterations

Table 3.4.8 Continued

Regression weights

, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

Fishing mortalities

Age,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
0,	.012,	.042,	.010,	.027,	.014,	.042,	.135,	.031,	.076,	.034
1,	.192,	.348,	.143,	.360,	.138,	.229,	.115,	.192,	.167,	.121
2,	.259,	.424,	.505,	.430,	.474,	.549,	.486,	.353,	.383,	.288
3,	.656,	.768,	.874,	.660,	.731,	.927,	.513,	.551,	.673,	.500
4,	.860,	1.247,	1.287,	.964,	.866,	.998,	.873,	.623,	.790,	.728
5,	1.205,	1.131,	1.449,	1.128,	1.578,	1.236,	1.146,	.880,	.864,	.977
6,	1.349,	1.320,	1.635,	1.363,	1.571,	1.043,	.781,	1.205,	1.093,	1.143
7,	1.569,	1.450,	1.921,	.719,	1.574,	1.070,	1.176,	1.275,	1.298,	1.330
8,	2.119,	1.476,	1.899,	.735,	2.640,	3.356,	2.994,	.668,	1.926,	2.231
9,	1.424,	1.390,	1.633,	.965,	1.663,	1.751,	1.321,	1.061,	1.262,	1.307

XSA population numbers (Thousands)

	AGE								
YEAR ,	0,	1,	2,	3,	4,	5,	6,	7,	8,	9,
1985 ,	5.40E+07,	1.88E+06,	8.03E+05,	2.11E+05,	7.66E+04,	2.24E+04,	2.79E+04,	4.44E+03,	1.07E+03,	1.40E+02,
1986 ,	4.27E+07,	4.17E+06,	6.00E+05,	3.95E+05,	7.73E+04,	2.40E+04,	5.22E+03,	5.65E+03,	7.57E+02,	1.05E+02,
1987	2.94E+07,	3.19E+06,	1.14E+06,	2.50E+05,	1.29E+05,	1.64E+04,	6.04E+03,	1.09E+03,	1.08E+03,	1.42E+02,
1988	5.69E+07,	2.27E+06,	1.07E+06,	4.38E+05,	7.36E+04,	2.64E+04,	3.01E+03,	9.17E+02,	1.30E+02,	1.33E+02,
1989	2.53E+07,	4.33E+06,	6.13E+05,	4.44E+05,	1.59E+05,	2.08E+04,	6.66E+03,	6.00E+02,	3.66E+02,	5.12E+01,
1990 ,	2.50E+07,	1.95E+06,	1.46E+06,	2.43E+05,	1.51E+05,	4.97E+04,	3.34E+03,	1.08E+03,	1.02E+02,	2.14E+01,
1991 ,	2.95E+07,	1.87E+06,	5.99E+05,	5.37E+05,	6.79E+04,	4.11E+04,	1.12E+04,	9.17E+02,	3.03E+02,	2.91E+00,
1992 ,	2.98E+07,	2.01E+06,	6.46E+05,	2.35E+05,	2.26E+05,	2.10E+04,	1.02E+04,	4.01E+03,	2.32E+02,	1.24E+01,
1993 ,	3.06E+07,	2.26E+06,	6.42E+05,	2.90E+05,	9.53E+04,	9.00E+04,	6.79E+03,	2.38E+03,	9.16E+02,	9.72E+01,
1994 ,	2.35E+07,	2.21E+06,	7.39E+05,	2.79E+05,	1.04E+05,	3.20E+04,	2.95E+04,	1.77E+03,	5.31E+02,	1.09E+02,

Estimated population abundance at 1st Jan 1995

, 0.00E+00, 1.77E+06, 7.58E+05, 3.53E+05, 1.19E+05, 3.72E+04, 9.40E+03, 7.34E+03, 3.84E+02, 4.67E+01,

Taper weighted geometric mean of the VPA populations:

, 3.17E+07, 2.45E+06, 7.91E+05, 3.35E+05, 1.19E+05, 3.60E+04, 9.27E+03, 1.94E+03, 4.44E+02, 5.93E+01,

Standard error of the weighted Log(VPA populations) :

, .3186, .3375, .3638, .3714, .4526, .5851, .7393, .7407, .8042, 1.2777,

Fleet : SCOSEI

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	1.16,	-.165,	17.96,	.09,	20,	1.10,	-17.51,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.81,	.473,	15.20,	.38,	20,	.48,	-15.57,
3,	1.73,	-1.898,	16.03,	.40,	20,	.47,	-14.64,
4,	1.20,	-.809,	14.71,	.62,	20,	.37,	-14.20,
5,	.96,	.146,	13.80,	.62,	20,	.48,	-13.92,
6,	1.00,	-.021,	13.83,	.81,	20,	.37,	-13.82,
7,	.92,	.395,	13.39,	.71,	20,	.50,	-13.89,
8,	.97,	.118,	13.34,	.56,	19,	.74,	-13.58,
9,	.67,	.914,	11.26,	.47,	17,	1.01,	-14.60,

Tabl3 3.4.8 Continued

Fleet : SCOLTR

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	-1.13,	-1.375,	11.57,	.04,	20,	1.64,	-22.32,
1,	1.19,	-.168,	18.18,	.07,	20,	1.27,	-17.63,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.96,	.137,	16.14,	.49,	20,	.39,	-16.26,
3,	.98,	.074,	15.37,	.57,	20,	.34,	-15.43,
4,	.87,	.691,	14.61,	.73,	20,	.29,	-15.05,
5,	.82,	1.258,	13.99,	.82,	20,	.29,	-14.79,
6,	.77,	1.878,	13.41,	.87,	20,	.30,	-14.68,
7,	.65,	2.591,	12.22,	.84,	20,	.33,	-14.74,
8,	.77,	1.153,	12.41,	.71,	20,	.54,	-14.32,
9,	.81,	.777,	13.01,	.64,	19,	1.01,	-15.04,

Fleet : FRATRB

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	-6.06,	-.946,	-.13,	.00,	19,	7.91,	-20.14,
1,	1.08,	-.164,	16.03,	.32,	19,	.52,	-15.94,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	1.02,	-.066,	14.86,	.44,	19,	.43,	-14.84,
3,	1.43,	-1.615,	14.60,	.58,	19,	.33,	-14.03,
4,	.94,	.332,	13.53,	.78,	19,	.25,	-13.64,
5,	.93,	.535,	13.18,	.84,	19,	.27,	-13.39,
6,	1.02,	-.096,	13.34,	.80,	19,	.39,	-13.27,
7,	.97,	.253,	12.96,	.91,	19,	.25,	-13.10,
8,	.82,	.869,	11.82,	.69,	19,	.56,	-13.10,
9,	.90,	.571,	12.26,	.77,	19,	.74,	-13.16,

Fleet : SCOGFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	-1.70,	-1.433,	14.89,	.03,	13,	1.81,	-18.66,
1,	2.48,	-1.003,	17.26,	.05,	13,	1.44,	-15.73,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.88,	.437,	15.10,	.59,	13,	.28,	-15.32,
3,	1.04,	-.101,	15.42,	.46,	13,	.40,	-15.32,
4,	.60,	2.324,	13.88,	.79,	13,	.25,	-15.38,
5,	.85,	.558,	14.54,	.61,	13,	.50,	-15.25,
6,	1.09,	-.473,	15.83,	.74,	13,	.47,	-15.25,

Table 3.4.8 Continued

Fleet : ENGGFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	-7.78,	-1.508,	20.21,	.00,	18,	6.14,	-16.89,
1,	7.06,	-2.792,	19.83,	.02,	18,	2.43,	-15.44,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	2.09,	-2.265,	17.04,	.30,	18,	.58,	-15.24,
3,	1.17,	-.392,	15.86,	.34,	18,	.54,	-15.40,
4,	1.40,	-.952,	16.82,	.36,	18,	.63,	-15.35,
5,	2.69,	-1.987,	23.71,	.12,	18,	1.66,	-15.40,
6,	1.32,	-.574,	17.49,	.24,	18,	1.39,	-15.44,

Fleet : INTGFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	1.52,	-.591,	14.13,	.11,	20,	.94,	-15.21,
1,	1.56,	-.786,	14.07,	.17,	20,	.79,	-14.30,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.65,	1.437,	13.99,	.65,	13,	.25,	-14.24,
3,	.99,	.016,	14.43,	.43,	13,	.42,	-14.44,
4,	.96,	.150,	14.50,	.57,	13,	.42,	-14.63,
5,	1.91,	-1.485,	17.76,	.23,	13,	1.15,	-14.28,

Fleet : NETGFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	-25.57,	-.916,	62.01,	.00,	15,	28.56,	-15.50,
1,	3.30,	-1.009,	13.41,	.02,	15,	2.40,	-14.30,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	3.65,	-.936,	16.91,	.01,	15,	3.26,	-14.48,
3,	-2.31,	-1.552,	7.45,	.02,	15,	2.57,	-14.99,

Table 3.4.8 Continued

Fleet : FRGGFS

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	2.13,	-.283,	19.63,	.01,	11,	3.81,	-17.02,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.89,	.103,	15.61,	.11,	11,	.99,	-15.86,
3,	.58,	.795,	14.36,	.32,	11,	.52,	-15.61,
4,	.86,	.210,	15.05,	.23,	11,	.92,	-15.60,
5,	1.63,	-.605,	18.64,	.11,	11,	1.63,	-15.43,
6,	31.15,	-1.739,	203.58,	.00,	11,	41.14,	-15.37,

Fleet : IBTS_Q2_SCO

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	-.90,	-.915,	14.88,	.10,	4,	.31,	-14.18,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	-1.10,	-2.363,	12.74,	.39,	4,	.13,	-13.99,
3,	1.16,	-.188,	14.51,	.40,	4,	.54,	-14.25,
4,	42.81,	-2.090,	135.45,	.00,	4,	17.59,	-14.51,
5,	.91,	.259,	13.97,	.82,	4,	.36,	-14.29,
6,	1.98,	-12.738,	18.97,	.99,	4,	.08,	-14.23,

Fleet : IBTS_Q4

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	-1.23,	-1.382,	20.12,	.16,	4,	.34,	-14.74,
1,	.80,	.143,	13.92,	.21,	4,	.21,	-13.76,

Terminal year survivor and F summaries :

Table 3.4.8 Continued

Age 0 Catchability dependent on age and year class strength

Year class = 1994

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	1,	.000,	.000,	.00,	0,	.000,	.000
SCOLTR	2064057,	1.710,	.000,	.00,	1,	.023,	.000
FRATRB	1640185,	8.232,	.000,	.00,	1,	.001,	.000
SCOGFS	1532485,	1.893,	.000,	.00,	1,	.019,	.000
ENGGFS	32108818,	6.446,	.000,	.00,	1,	.002,	.000
INTGFS	2877951,	.976,	.000,	.00,	1,	.070,	.000
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean	2454871,	.34,,,,				.608,	.024
F shrinkage mean	754434,	.50,,,,				.277,	.077

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1773953,	.26,	.26,	7,	1.002,	.034

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	775425,	1.140,	.000,	.00,	1,	.036,	.119
SCOLTR	378550,	1.092,	1.028,	.94,	2,	.038,	.230
FRATRB	956722,	.540,	.558,	1.03,	2,	.161,	.097
SCOGFS	2207622,	1.198,	.092,	.08,	2,	.032,	.043
ENGGFS	3366893,	2.382,	.169,	.07,	2,	.008,	.029
INTGFS	829029,	.633,	.233,	.37,	2,	.113,	.111
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
P shrinkage mean	790736,	.36,,,,				.400,	.116
F shrinkage mean	506599,	.50,,,,				.212,	.176

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
757736,	.22,	.14,	13,	.638,	.121

Table 3.4.8 Continued

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	325740,	.531,	.063,	.12,	2,	.067,	.308
SCOLTR	265947,	.378,	.100,	.26,	3,	.135,	.366
FRATRB	624375,	.332,	.136,	.41,	3,	.169,	.173
SCOGFS	326845,	.313,	.321,	1.03,	3,	.198,	.308
ENGGFS	332067,	.334,	.112,	.34,	3,	.175,	.303
INTGFS	435457,	.351,	.208,	.59,	3,	.152,	.239
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	202554,	.50,,,,				.104,	.458

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
353203,	.14,	.10,	18,	.728,	.288

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	132492,	.276,	.136,	.49,	3,	.145,	.460
SCOLTR	102764,	.258,	.153,	.59,	4,	.157,	.561
FRATRB	157943,	.228,	.101,	.44,	4,	.201,	.398
SCOGFS	116909,	.247,	.244,	.99,	4,	.163,	.508
ENGGFS	107349,	.276,	.143,	.52,	4,	.128,	.542
INTGFS	120796,	.277,	.122,	.44,	4,	.128,	.495
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	77604,	.50,,,,				.078,	.691

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
119227,	.10,	.07,	24,	.639,	.500

Table 3.4.8 Continued

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	38699,	.222,	.061,	.27,	4,	.176,	.709
SCOLTR	28385,	.220,	.078,	.35,	5,	.172,	.878
FRATRB	47441,	.196,	.169,	.86,	5,	.215,	.611
SCOGFS	35133,	.241,	.251,	1.04,	5,	.117,	.759
ENGGFS	42192,	.259,	.151,	.58,	5,	.110,	.666
INTGFS	37305,	.254,	.178,	.70,	5,	.119,	.728
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	30128,	.50,,,,				.090,	.844

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
37243,	.10,	.06,	30,	.660,	.728

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	11034,	.224,	.068,	.30,	5,	.147,	.880
SCOLTR	7609,	.215,	.044,	.20,	6,	.184,	1.113
FRATRB	9875,	.186,	.067,	.36,	6,	.258,	.946
SCOGFS	12335,	.263,	.119,	.45,	6,	.100,	.816
ENGGFS	9976,	.278,	.096,	.35,	6,	.084,	.940
INTGFS	10189,	.270,	.114,	.42,	6,	.093,	.927
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	7119,	.50,,,,				.134,	1.158

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
9397,	.11,	.04,	36,	.390,	.977

Table 3.4.8 Continued

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	8682,	.230,	.090,	.39,	6,	.184,	1.031
SCOLTR	6664,	.225,	.071,	.31,	7,	.167,	1.209
FRATRB	7462,	.192,	.103,	.54,	7,	.232,	1.131
SCOGFS	7493,	.276,	.153,	.56,	7,	.129,	1.129
ENGGFS	5072,	.314,	.111,	.35,	7,	.058,	1.408
INTGFS	7803,	.260,	.220,	.85,	6,	.050,	1.101
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	7197,	.50,,,,				.180,	1.156

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
7335,	.12,	.04,	41,	.357,	1.143

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	337,	.288,	.062,	.22,	7,	.152,	1.427
SCOLTR	304,	.303,	.055,	.18,	8,	.120,	1.505
FRATRB	390,	.224,	.080,	.36,	8,	.312,	1.318
SCOGFS	373,	.306,	.122,	.40,	7,	.056,	1.351
ENGGFS	809,	.375,	.136,	.36,	7,	.022,	.841
INTGFS	771,	.304,	.133,	.44,	6,	.018,	.869
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	403,	.50,,,,				.319,	1.295

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
384,	.18,	.04,	44,	.204,	1.330

Table 3.4.8 Continued

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	70,	.410,	.134,	.33,	8,	.067,	1.880
SCOLTR	64,	.462,	.145,	.31,	9,	.055,	1.952
FRATRB	66,	.291,	.099,	.34,	9,	.113,	1.924
SCOGFS	100,	.325,	.153,	.47,	7,	.012,	1.585
ENGGFS	107,	.421,	.354,	.84,	7,	.004,	1.534
INTGFS	85,	.303,	.113,	.37,	6,	.003,	1.717
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	41,	.50,,,,				.746,	2.350

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
47,	.38,	.07,	47,	.190,	2.231

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
SCOSEI	25,	.687,	.098,	.14,	9,	.045,	1.284
SCOLTR	26,	.757,	.094,	.12,	10,	.053,	1.266
FRATRB	22,	.523,	.088,	.17,	10,	.122,	1.367
SCOGFS	17,	.327,	.075,	.23,	7,	.007,	1.566
ENGGFS	16,	.421,	.185,	.44,	7,	.002,	1.635
INTGFS	24,	.295,	.102,	.35,	6,	.002,	1.309
NETGFS	1,	.000,	.000,	.00,	0,	.000,	.000
FRGGFS	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q2_SCO	1,	.000,	.000,	.00,	0,	.000,	.000
IBTS_Q4	1,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	25,	.50,,,,				.769,	1.298

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
24,	.39,	.02,	50,	.053,	1.307

TABLE 3.4.9 Whiting, North Sea
International F at age, Total , 1960 to 1994.

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.005	.010	.003	.021	.023	.007	.005	.005	.027	.176
1	.212	.756	.331	.142	.169	.225	.417	.419	.159	.815
2	.466	.970	.642	.865	.237	.516	.713	.568	.805	.562
3	1.454	1.406	.973	.874	.605	.465	1.012	.783	.867	.803
4	2.294	1.293	.969	1.058	.609	.732	.989	.917	1.060	.667
5	1.526	1.502	1.005	.989	.896	.512	1.291	.830	.947	1.075
6	1.759	1.758	2.714	.990	1.013	.990	2.032	1.125	1.338	.624
7	1.778	1.129	.936	.848	.751	.973	2.139	1.642	1.012	1.105
8	1.918	1.888	1.714	.848	.337	.520	1.932	1.344	.871	1.251
9	1.881	1.534	1.487	.957	.728	.752	1.700	1.186	1.058	.955
10+	1.881	1.534	1.487	.957	.728	.752	1.700	1.186	1.058	.955

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.090	.064	.020	.014	.022	.014	.026	.041	.040	.031
1	.705	.405	.323	.295	.409	.232	.182	.444	.162	.238
2	.818	.528	.720	.822	.872	.783	.956	.508	.427	.496
3	.915	.552	.629	1.067	1.055	1.014	1.262	.862	.648	.751
4	.802	.623	.612	.638	1.007	1.002	1.039	.977	.863	.698
5	.681	.531	1.037	1.397	.361	1.031	.870	.929	.765	.892
6	1.178	.280	1.252	.971	1.871	2.146	1.235	1.056	1.204	.981
7	1.448	.764	2.247	1.491	1.062	1.088	.957	.824	1.659	.984
8	.788	.802	.823	1.569	.869	.830	.483	2.476	1.603	1.285
9	.990	.605	1.209	1.228	1.046	1.235	.925	1.265	1.217	.962
10+	.990	.605	1.209	1.228	1.046	1.235	.925	1.265	1.217	.962

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.056	.075	.016	.068	.027	.012	.042	.010	.027	.014
1	.104	.175	.180	.208	.232	.192	.348	.143	.360	.138
2	.450	.331	.285	.447	.493	.259	.424	.505	.430	.474
3	.836	.753	.516	.731	.805	.655	.768	.874	.660	.731
4	1.011	.976	.734	.730	1.043	.860	1.247	1.287	.964	.866
5	1.253	1.101	.892	.924	1.055	1.205	1.131	1.449	1.128	1.578
6	1.192	1.279	1.152	.984	1.306	1.349	1.320	1.635	1.363	1.571
7	1.243	1.584	.917	1.286	1.242	1.569	1.450	1.921	.719	1.574
8	2.307	1.222	1.125	1.230	1.254	2.119	1.475	1.899	.735	2.640
9	1.413	1.241	.964	.986	1.146	1.424	1.390	1.633	.965	1.663
10+	1.413	1.241	.964	.986	1.146	1.424	1.390	1.633	.965	1.663

Age	1990	1991	1992	1993	1994
0	.042	.135	.031	.076	.034
1	.229	.115	.192	.167	.121
2	.549	.486	.353	.383	.288
3	.927	.513	.552	.673	.500
4	.998	.873	.623	.790	.728
5	1.236	1.146	.880	.864	.976
6	1.043	.781	1.205	1.093	1.143
7	1.070	1.176	1.275	1.298	1.330
8	3.356	2.994	.668	1.926	2.231
9	1.751	1.321	1.061	1.262	1.306
10+	1.751	1.321	1.061	1.262	1.306

TABLE 3.4.10 Whiting, North Sea
Tuned Stock Numbers at age (10**-5), 1960 to 1995, (numbers in 1995 are VPA survivors)

Age	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	422149	757736	845360	184592	359014	313049	587320	1142472	137431	257870
1	40585	32793	58567	65795	14121	27386	24266	45624	88717	10449
2	8844	12692	5954	16274	22067	4612	8461	6182	11609	29257
3	3413	3539	3068	1998	4368	11096	1755	2644	2234	3309
4	274	562	611	817	588	1680	4910	450	852	661
5	355	20	114	172	210	237	599	1353	133	219
6	51	60	4	33	50	67	111	128	460	40
7	12	7	8	0	9	14	19	11	32	94
8	30	2	2	3	0	4	4	2	2	10
9	3	4	0	0	1	0	2	1	0	1
10+	0	0	0	0	0	0	0	0	0	0

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	424622	731709	963846	474062	973980	601686	590406	598167	621929	568366
1	16886	30315	53581	73754	36514	74436	46310	44913	44849	46644
2	1789	3226	7820	15005	21243	9382	22827	14931	11137	14747
3	10640	504	1214	2427	4207	5664	2733	5597	5726	4635
4	1045	3002	204	456	589	1032	1448	545	1666	2110
5	251	347	1193	82	179	159	281	380	152	520
6	58	99	159	329	16	97	44	92	117	55
7	17	14	58	35	97	2	9	10	25	27
8	25	3	5	5	7	27	1	3	4	4
9	2	9	1	2	1	2	10	0	0	1
10+	0	1	14	1	0	0	1	2	0	0

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	219861	255177	224619	358722	247066	540443	426535	293815	569086	252836
1	43047	16239	18476	17256	26164	18786	41677	31938	22705	43270
2	14212	14998	5271	5966	5421	8027	5996	11377	10710	6126
3	5724	5776	6866	2528	2432	2112	3951	2503	4376	4441
4	1542	1749	1917	2887	858	766	773	1292	736	1593
5	778	415	488	682	1030	224	240	164	264	208
6	166	173	108	156	211	279	52	60	30	67
7	16	39	37	26	45	44	56	11	9	6
8	8	4	7	12	6	11	8	11	1	4
9	1	1	1	2	3	1	1	1	1	1
10+	0	1	1	1	0	0	0	0	1	0

Age	1990	1991	1992	1993	1994	1995
0	250331	294780	298136	305653	234948	0
1	19470	18748	20103	22575	22119	17740
2	14571	5987	6464	6416	7385	7577
3	2432	5367	2347	2896	2789	3532
4	1506	679	2264	953	1042	1192
5	497	411	210	900	320	372
6	33	112	102	68	295	94
7	11	9	40	24	18	73
8	1	3	2	9	5	4
9	0	0	0	1	1	0
10+	0	0	0	0	0	0

TABLE 3.4.11 Whiting, North Sea
Mean fishing mortality, biomass and recruitment, 1960 - 1994.

	Mean F			Stock Biomass		Recruits	
	H. cons.	Disc.	Ind. byc.	('000 tonnes)		Age 0	
	Ages	Ages	Ages				
Year	2 to 6	2 to 6	0 to 4	Total	Spawning	Yclass	Million
1960	1.054	.431	.014	758	322	1960	42215
1961	1.003	.376	.017	747	381	1961	75774
1962	.976	.262	.013	914	285	1962	84536
1963	.628	.289	.054	1152	465	1963	18459
1964	.518	.127	.039	704	519	1964	35901
1965	.469	.143	.032	767	457	1965	31305
1966	.923	.174	.131	641	393	1966	58732
1967	.616	.202	.033	798	309	1967	114247
1968	.724	.224	.070	1343	433	1968	13743
1969	.401	.193	.282	729	599	1969	25787
1970	.571	.227	.214	531	362	1970	42462
1971	.354	.128	.065	546	231	1971	73171
1972	.641	.136	.112	645	290	1972	96385
1973	.673	.166	.161	964	400	1973	47406
1974	.584	.134	.295	712	459	1974	97398
1975	.851	.216	.142	1155	476	1975	60169
1976	.641	.167	.272	1078	606	1976	59041
1977	.557	.116	.217	749	438	1977	59817
1978	.615	.077	.103	733	422	1978	62193
1979	.590	.072	.104	909	483	1979	56837
1980	.657	.217	.093	805	497	1980	21986
1981	.645	.083	.171	605	466	1981	25518
1982	.494	.102	.098	467	360	1982	22462
1983	.563	.144	.068	496	324	1983	35872
1984	.742	.127	.076	473	264	1984	24707
1985	.729	.079	.053	431	262	1985	54044
1986	.708	.144	.116	631	281	1986	42654
1987	.937	.157	.069	520	291	1987	29382
1988	.702	.106	.159	407	286	1988	56909
1989	.582	.190	.161	540	271	1989	25284
1990	.465	.273	.189	460	303	1990	25033
1991	.514	.128	.111	435	259	1991	29478
1992	.524	.126	.081	412	256	1992	29814
1993	.484	.204	.073	399	249	1993	30565
1994	.482	.169	.058	413	256	1994	23495

Arithmetic mean recruits, age 0, 1960 to 1992 : 47840
Geometric mean recruits, age 0, 1960 to 1992 : 41864

Table 3.4.12. Whiting North Sea
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N0	31700000	.53	WS0	.01	.16	M0	2.55	.09	MT0	.00	.10
N1	1773999	.26	WS1	.08	.14	M1	.95	.11	MT1	.11	.10
N2	757700	.22	WS2	.16	.10	M2	.45	.26	MT2	.92	.10
N3	353200	.14	WS3	.23	.09	M3	.35	.14	MT3	1.00	.10
N4	119200	.10	WS4	.28	.10	M4	.30	.14	MT4	1.00	.00
N5	37200	.10	WS5	.32	.12	M5	.25	.14	MT5	1.00	.00
N6	9400	.11	WS6	.36	.09	M6	.25	.14	MT6	1.00	.00
N7	7300	.12	WS7	.40	.17	M7	.20	.14	MT7	1.00	.00
N8	400	.18	WS8	.46	.23	M8	.20	.14	MT8	1.00	.00
N9	0	.38	WS9	.48	.35	M9	.20	.14	MT9	1.00	.00
N10	0	.39	WS10	.63	1.20	M10	.20	.14	MT10	1.00	.00

HC selectivity			HC.catch wt			Dis selectivity			Discrd catch wt		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
sH0	.00	2.12	WH0	.07	.94	sD0	.01	1.41	WD0	.03	.27
sH1	.01	.61	WH1	.19	.06	sD1	.07	.19	WD1	.09	.04
sH2	.07	.34	WH2	.23	.05	sD2	.20	.20	WD2	.15	.10
sH3	.27	.13	WH3	.27	.06	sD3	.21	.15	WD3	.20	.07
sH4	.51	.15	WH4	.31	.07	sD4	.17	.27	WD4	.22	.09
sH5	.73	.20	WH5	.34	.09	sD5	.19	.69	WD5	.23	.08
sH6	.82	.23	WH6	.38	.12	sD6	.10	.58	WD6	.25	.05
sH7	.91	.16	WH7	.42	.16	sD7	.16	1.13	WD7	.27	.19
sH8	2.06	.48	WH8	.46	.24	sD8	.01	2.10	WD8	.24	2.24
sH9	1.30	.14	WH9	.48	.35	sD9	.00	.00	WD9	.00	.00
sH10	.53	.92	WH10	.63	1.20	sD10	.18	.00	WD10	.00	.00

Ind selectivity			Industrial wt		
Labl	Value	CV	Labl	Value	CV
sI0	.03	.69	WI0	.01	.34
sI1	.05	.39	WI1	.07	.37
sI2	.08	.27	WI2	.14	.10
sI3	.08	.49	WI3	.23	.14
sI4	.06	.25	WI4	.27	.25
sI5	.04	.72	WI5	.35	.30
sI6	.06	.44	WI6	.33	.42
sI7	.07	1.59	WI7	.35	.20
sI8	.06	1.98	WI8	.26	.99
sI9	.00	.00	WI9	.00	.00
sI10	.00	.00	WI10	.00	.00

Year effect M			HC relative eff			Ind reltive eff		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
K95	1.00	.23	HF95	1.00	.06	IF95	1.00	.51
K96	1.00	.23	HF96	1.00	.06	IF96	1.00	.51
K97	1.00	.23	HF97	1.00	.06	IF97	1.00	.51

Recruitment		
Labl	Value	CV
R96	31700000	.53
R97	31700000	.53

Stock numbers in 1995 are VPA survivors.

Human consumption + discard Fs are obtained from mean exploitation pattern over 1990 to 1994.
This is scaled to give a value for mean F (ages 2 to 6) equal to that in 1994, i.e. .651
Fs are distributed between consumption and discards by mean proportion retained over 1990 to 1994.
N.B. Above value for H. con+Disc. ref F is value for both catch categories combined.
Bycatch Fs are obtained from mean exploitation pattern over 1990 to 1994.
This is scaled to give a value for mean F (ages 0 to 4) equal to that in 1994, i.e. .058

E:\ACFM\WGNSSK96\WHG_NSEA\T3412.REP 27/10/95 16:13

Table 3.4.13. Whiting North Sea
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	1995	1996						
Mean F Ages								
H.cons 2 to 6	.65	.00	.13	.26	.39	.52	.65	.78
Ind BC 0 to 4	.06	.06	.06	.06	.06	.06	.06	.06
Effort relative to 1994								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Biomass at start of year								
Total	402	432	432	432	432	432	432	432
Spawning	263	250	250	250	250	250	250	250
Catch weight (,000t)								
H.cons	47	0	12	22	32	40	48	55
Discards	39	0	9	17	24	32	39	45
Ind BC	19	21	21	20	20	19	19	18
Total Landings	65	21	32	42	51	59	66	73
Total Catch	104	21	41	59	76	91	105	118
Biomass at start of 1997								
Total		533	513	496	480	465	451	439
Spawning		346	327	310	294	280	267	255

	Year							
	1995	1996						
Effort relative to 1994								
H.cons	1.00	.00	.20	.40	.60	.80	1.00	1.20
Ind BC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Est. Coeff. of Variation								
Biomass at start of year								
Total	.13	.45	.45	.45	.45	.45	.45	.45
Spawning	.13	.24	.24	.24	.24	.24	.24	.24
Catch weight								
H.cons	.13	.00	.34	.23	.20	.20	.19	.19
Discards	.19	.00	.44	.37	.36	.35	.35	.36
Ind BC	.57	.62	.62	.63	.63	.63	.63	.64
Biomass at start of 1997								
Total		.48	.49	.50	.51	.52	.53	.54
Spawning		.44	.45	.46	.48	.49	.50	.51

Table 3.4.14 Whiting North Sea
Detailed forecast tables.

Forecast for year 1995
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	31700000	0	67969	362499	430468
1	1773999	5433	80406	51068	136907
2	757700	35589	103104	40299	178992
3	353200	62871	49416	17400	129687
4	119200	38004	12396	4231	54631
5	37200	15680	4023	930	20633
6	9400	4455	515	314	5284
7	7300	3649	656	278	4582
8	400	320	1	9	330
9	0	0	0	0	0
10	0	0	0	0	0
Wt	402	47	39	19	104

Forecast for year 1996
F multiplier H.cons=1.00
F multiplier Indust=1.00

Populations		Catch number			
Age	Stock No.	H.Cons	Discards	By-catch	Total
0	31700000	0	67969	362499	430468
1	2382896	7298	108004	68597	183898
2	604857	28410	82306	32170	142886
3	343191	61090	48015	16907	126012
4	142314	45374	14800	5051	65225
5	42301	17830	4574	1058	23462
6	11160	5289	611	373	6273
7	2761	1380	248	105	1733
8	1913	1530	6	41	1577
9	39	26	0	0	26
10	0	0	0	0	0
Wt	433	48	39	19	105

Table 3.4.15

Stock: Whiting in Sub-area IV (North Sea)

Assessment Quality Control Diagram 1

Average F(2-6,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	1.17	0.81						
1990	1.07	0.78	0.69					
1991	1.10	0.82	0.81	0.77				
1992	1.10	0.82	0.79	0.87	0.96			
1993	1.10	0.82	0.78	0.78	0.70	0.85		
1994	1.09	0.81	0.77	0.74	0.64	0.64	0.68	
1995	1.09	0.81	0.77	0.74	0.64	0.65	0.69	0.65

Remarks: Reference F for human consumption (landings and discards) ages 2-6,u.

Assessment Quality Control Diagram 2

Recruitment (age 0) Unit: millions								
Date of assessment	Year class							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	39212	70480						
1990	50113	72010	48155					
1991	28474	64780	44169	65840				
1992	26333	46065	38134	45240	43856			
1993	28386	52593	23286	20814	48623	49573		
1994	29365	56305	25500	26834	34605	34700	38551	
1995	29382	56909	25284	25033	29478	29814	30565	23495

Remarks:

Table 3.4.16

Stock: Whiting in Sub-area IV (North Sea)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	265	325	391[1]	354[1]						
1990	283	365	474	444[1]	375[1]					
1991	273	269	351	400	422[1]	347[1]				
1992	267	243	264	291	305	308[1]	286[1]			
1993	279	261	286	228	209	265	315[1]	289[1]		
1994	286	271	301	259	267	284	297	325[1]	360[1]	
1995	286	271	303	259	256	249	256	263	250[1]	267[1]

[1]Forecast.

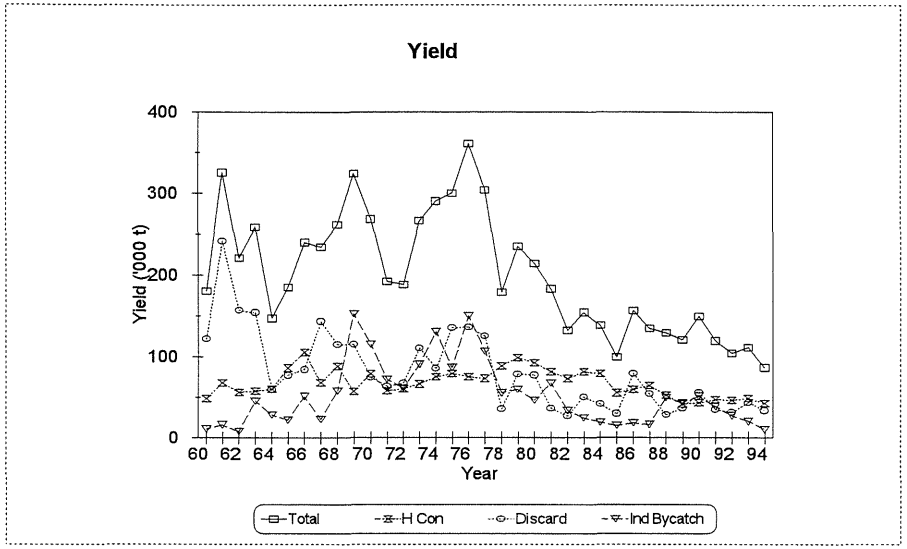
Remarks:

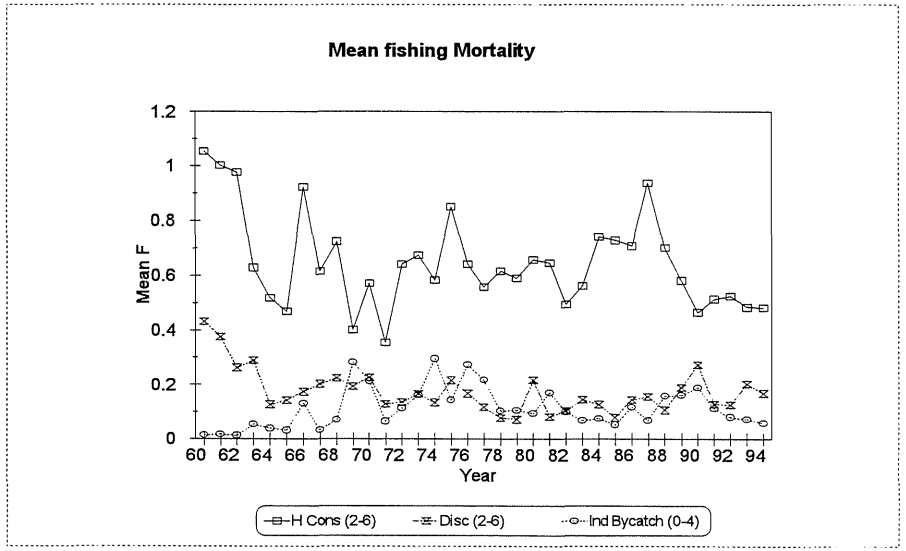
Table 3.4.17 Whiting in the North Sea. Inclusion of the IBTS quarterly survey data in single species assessments.

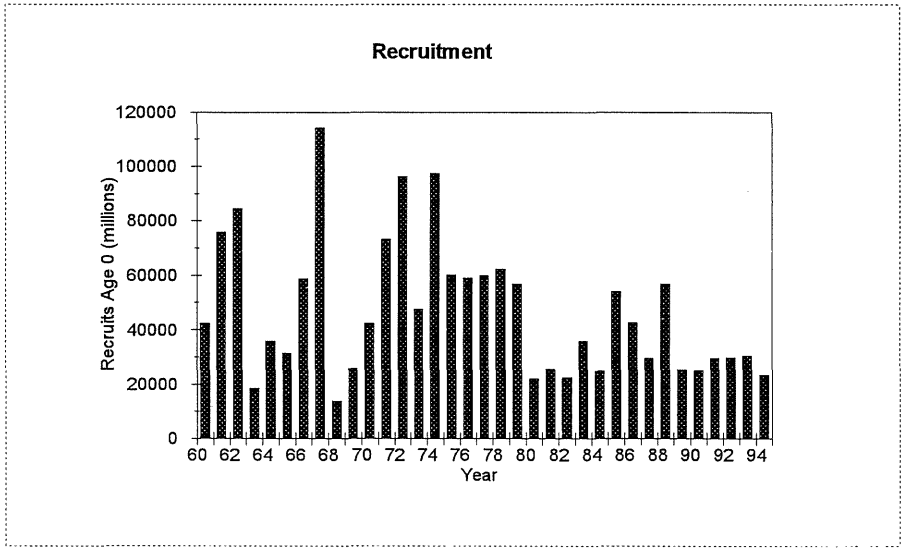
Estimates of survivors in tuning runs which include and exclude the new survey series:

	Final XSA (which excludes IBTS)		XSA including new IBTS					
Age	Survivors (age + 1)	ext SE	Survivors (age + 1)	ext SE	IBTS Q2		IBTS Q4	
					Estimate	Weight	Estimate	Weight
0	1773953	.26	2088168	.19	n/a	n/a	2618431	.427
1	757736	.14	761205	.10	472723	.134	890870	.439
2	353203	.10	323942	.07	280914	.195	319078	.215
3	119227	.07	109282	.06	104758	.154	82597	.101
4	37243	.06	38023	.06	42295	.108	40351	.033

Figure 3.4.1 Whiting in the North sea. Stock trends 1960-1994







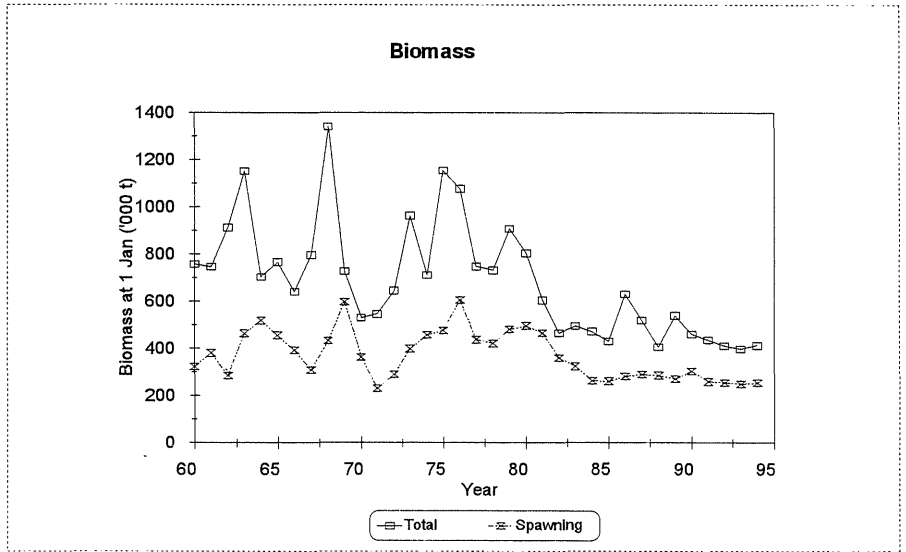
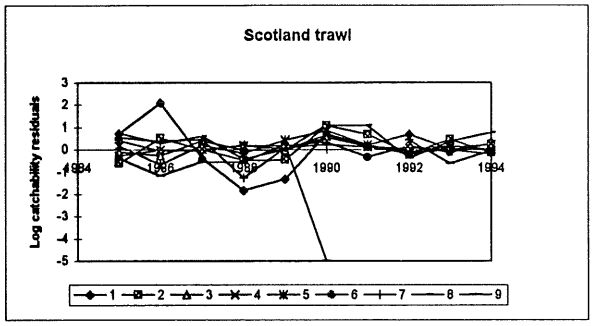
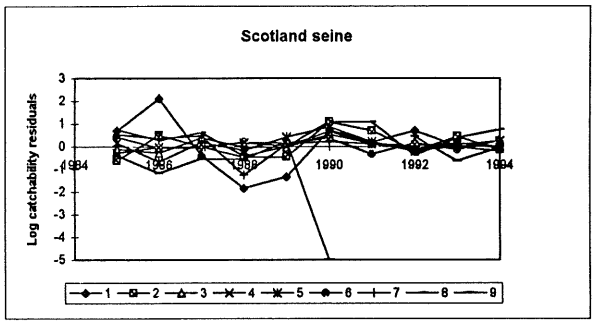
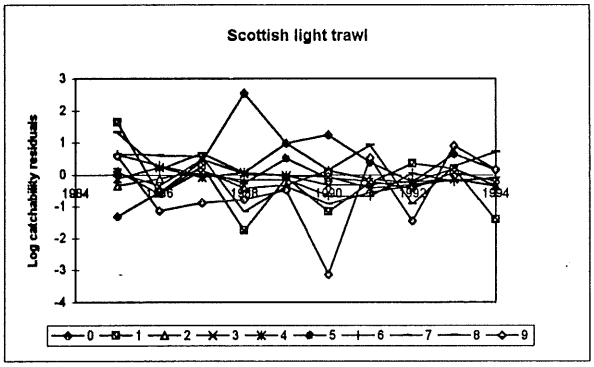
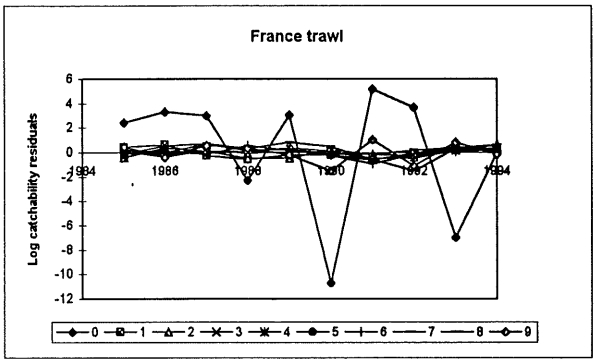


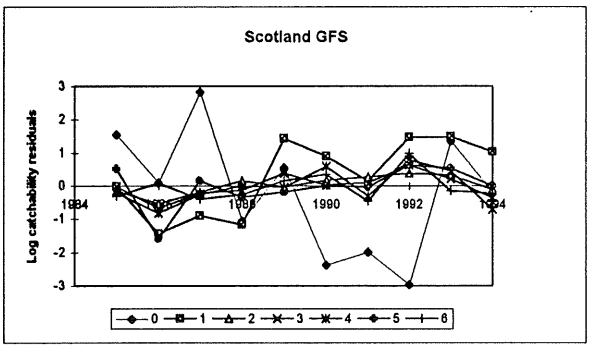
Figure 3.4.2

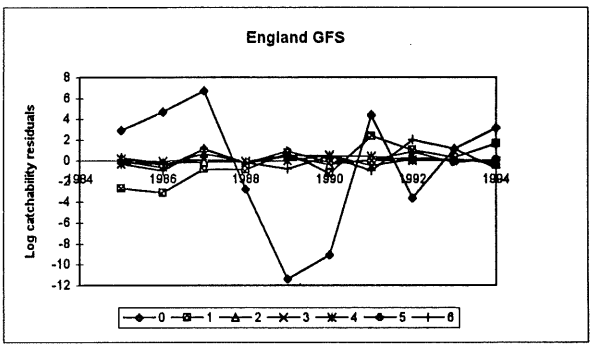

Scotland trawl
Log catchability residuals
1984
1986
1988
1990
1992
1994
1 2 3 4 5 6 7 8 9


Scotland seine
Log catchability residuals
1984
1986
1988
1990
1992
1994
1 2 3 4 5 6 7 8 9


Scottish light trawl
Log catchability residuals
1984
1986
1988
1990
1992
1994
0 1 2 3 4 5 6 7 8 9


France trawl
Log catchability residuals
1984
1986
1988
1990
1992
1994
0 1 2 3 4 5 6 7 8 9


Scotland GFS
Log catchability residuals
1984
1986
1988
1990
1992
1994
0 1 2 3 4 5 6


England GFS
Log catchability residuals
1984
1986
1988
1990
1992
1994
0 1 2 3 4 5 6

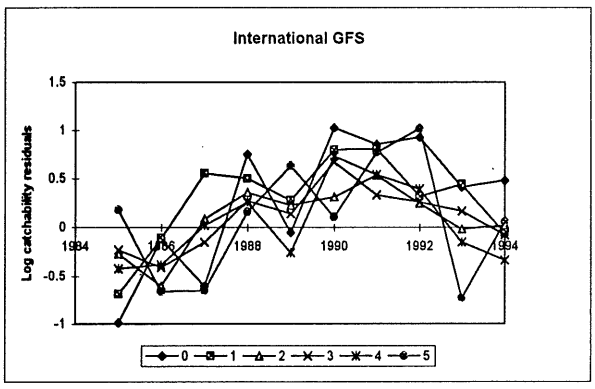
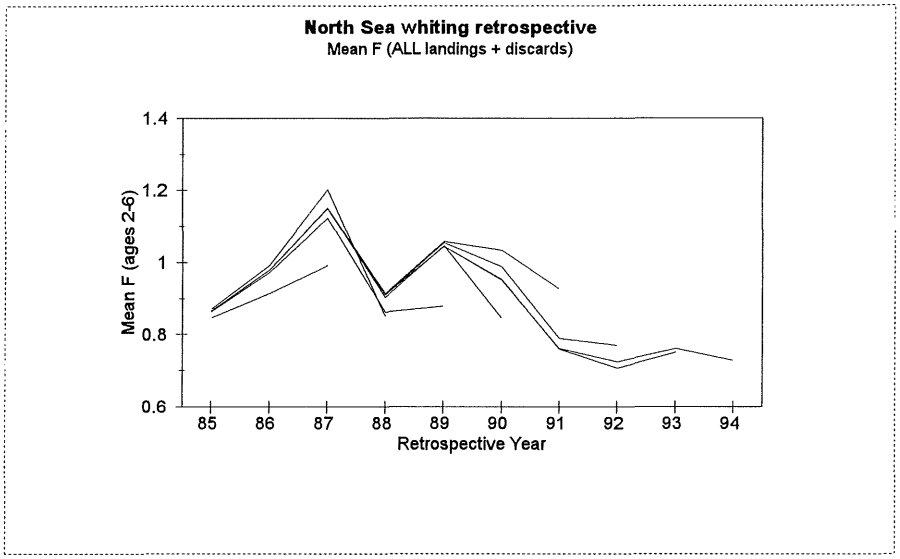
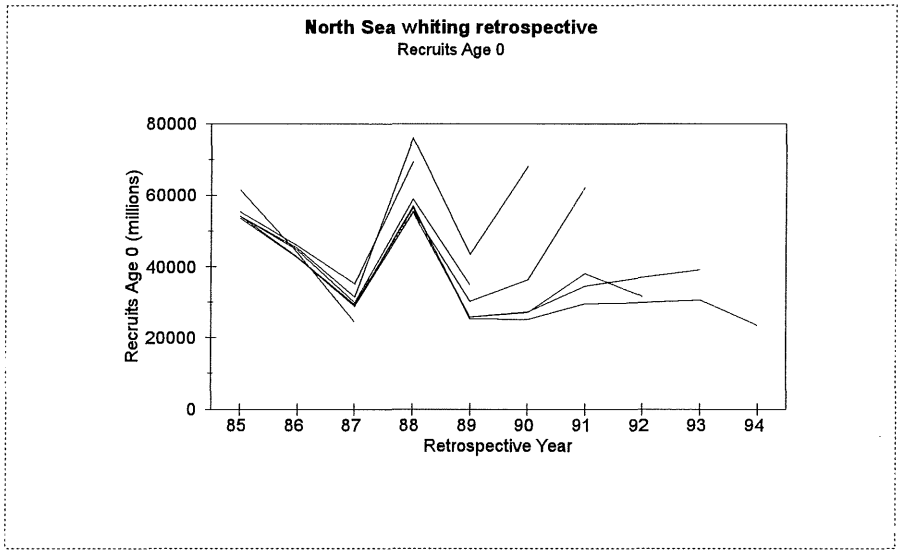

International GFS
Log catchability residuals
1984
1986
1988
1990
1992
1994
0 1 2 3 4 5

Figure 3.4.3 North Sea whiting, retrospective analysis

shrinkage SE = 0.5





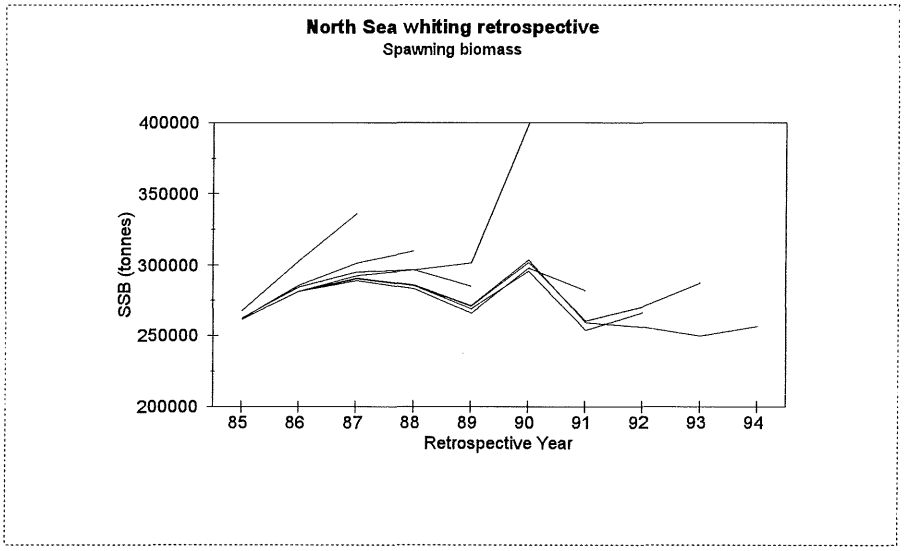
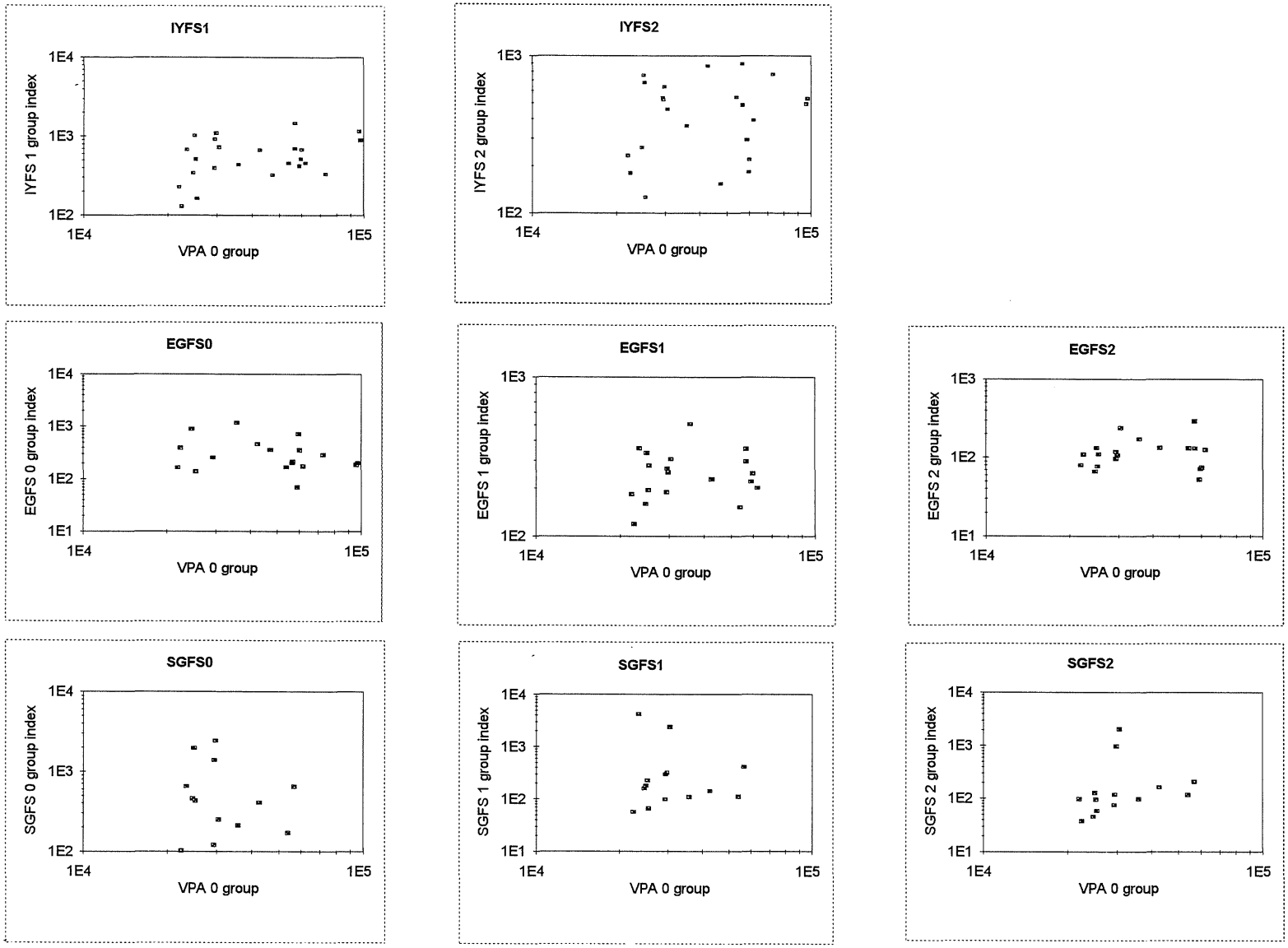
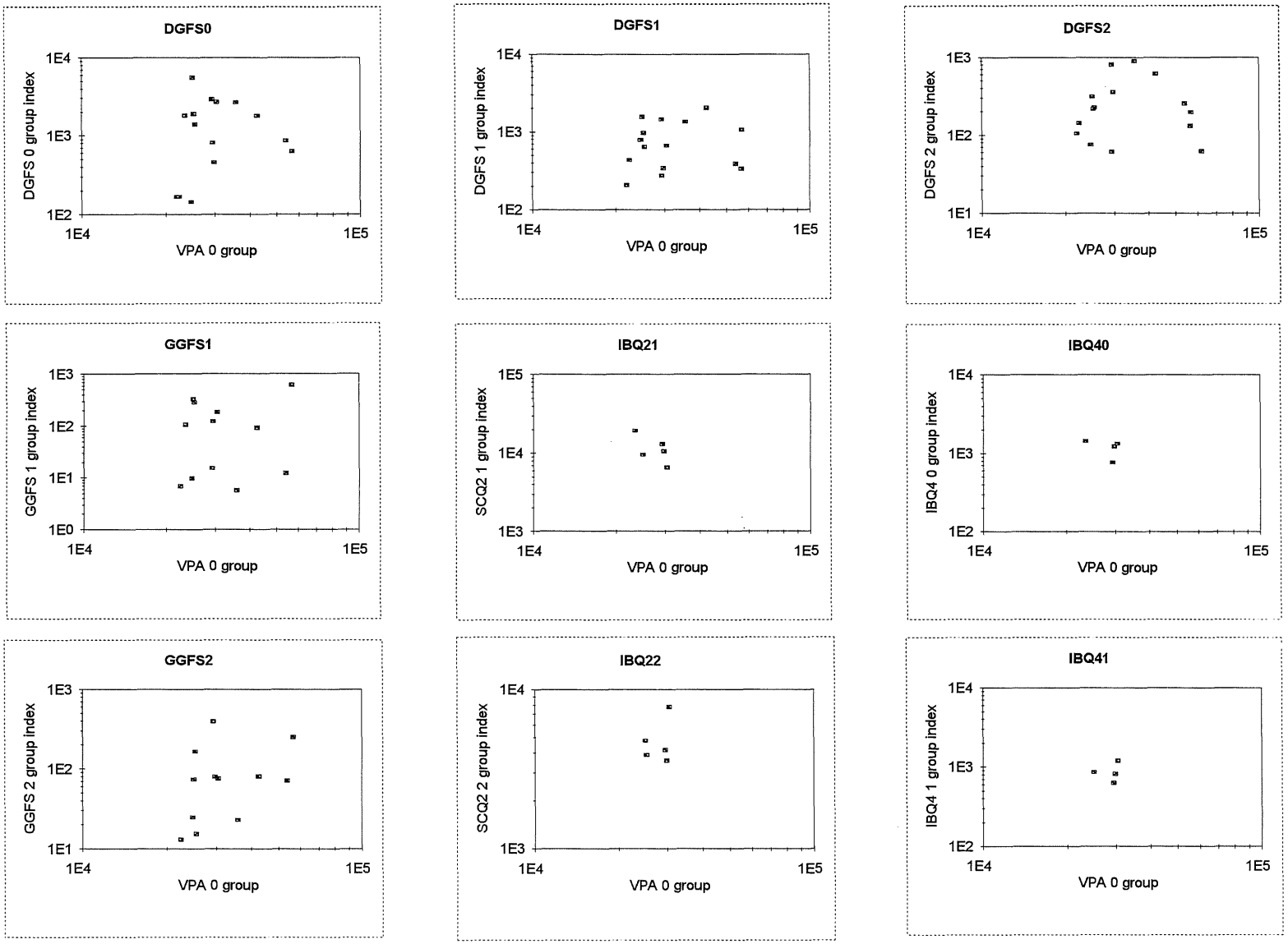


Figure 3.4.4 Whiting in the North Sea. Survey indices against VPA 0-group abundance.



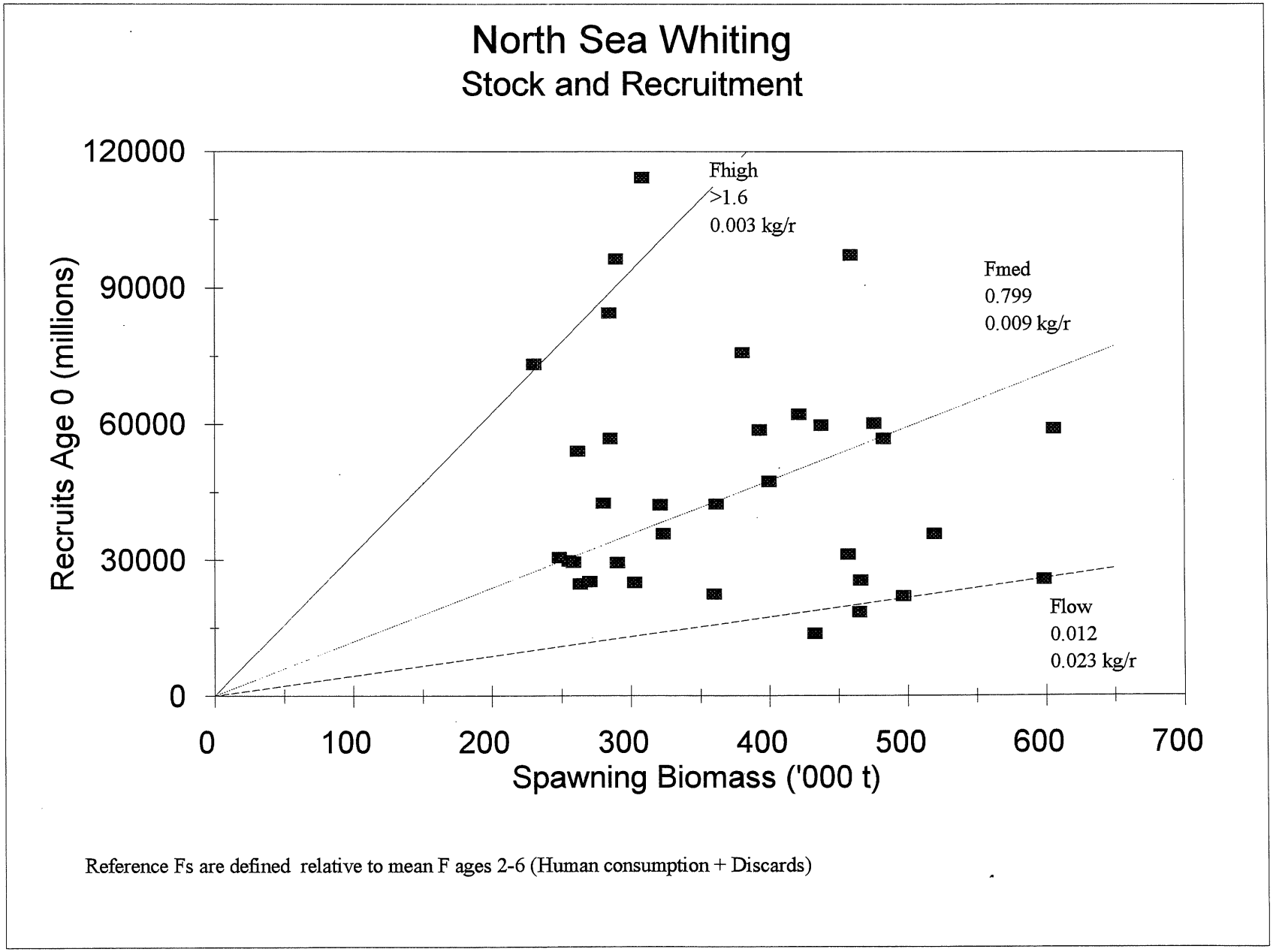
IYFS = International Young Fish Survey (now quarter 1 international bottom trawl survey)
EGFS = English groundfish survey
SGFS = Scottish groundfish survey

Figure 3.4.4 Contined Whiting in the North Sea. Survey indices against VPA 0-group abundance.



DGFS = Dutch grounfish survey
GGFS = German groundfish survey
IBQ2 = International bottom trawl survey quarter 2 (Scottish component)
IBQ4 = International bottom trawl survey quarter 4 (English component)

Figure 3.4.5



Reference Fs are defined relative to mean F ages 2-6 (Human consumption + Discards)

Figure 3.4.6

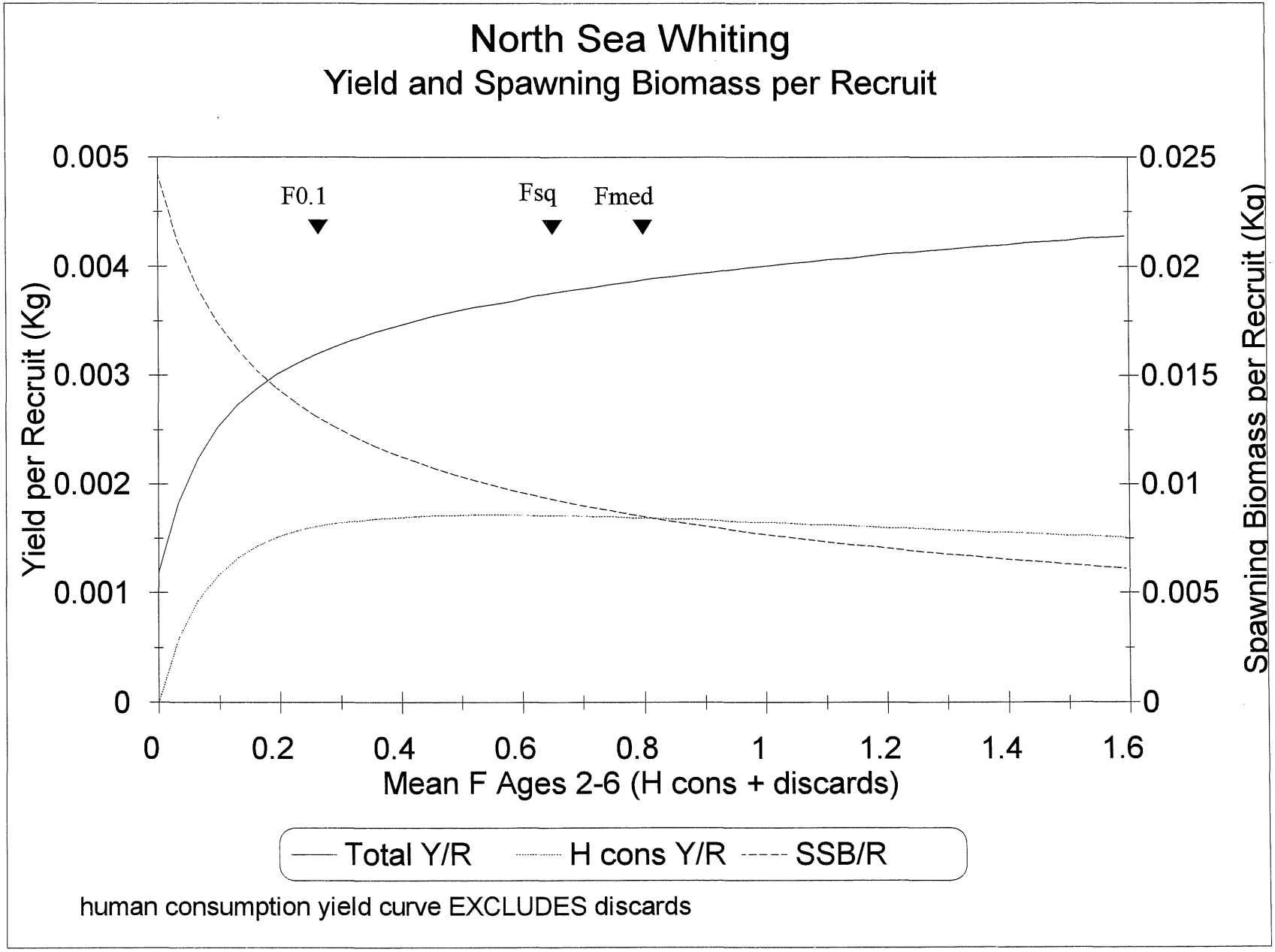

North Sea Whiting
Yield and Spawning Biomass per Recruit
Yield per Recruit (Kg)
Spawning Biomass per Recruit (Kg)
0.005
0.004
0.003
0.002
0.001
0
0.025
0.02
0.015
0.01
0.005
0
F0.1
Fsq
Fmed
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Mean F Ages 2-6 (H cons + discards)
Total Y/R
H cons Y/R
SSB/R
human consumption yield curve EXCLUDES discards

Figure 3.4.7

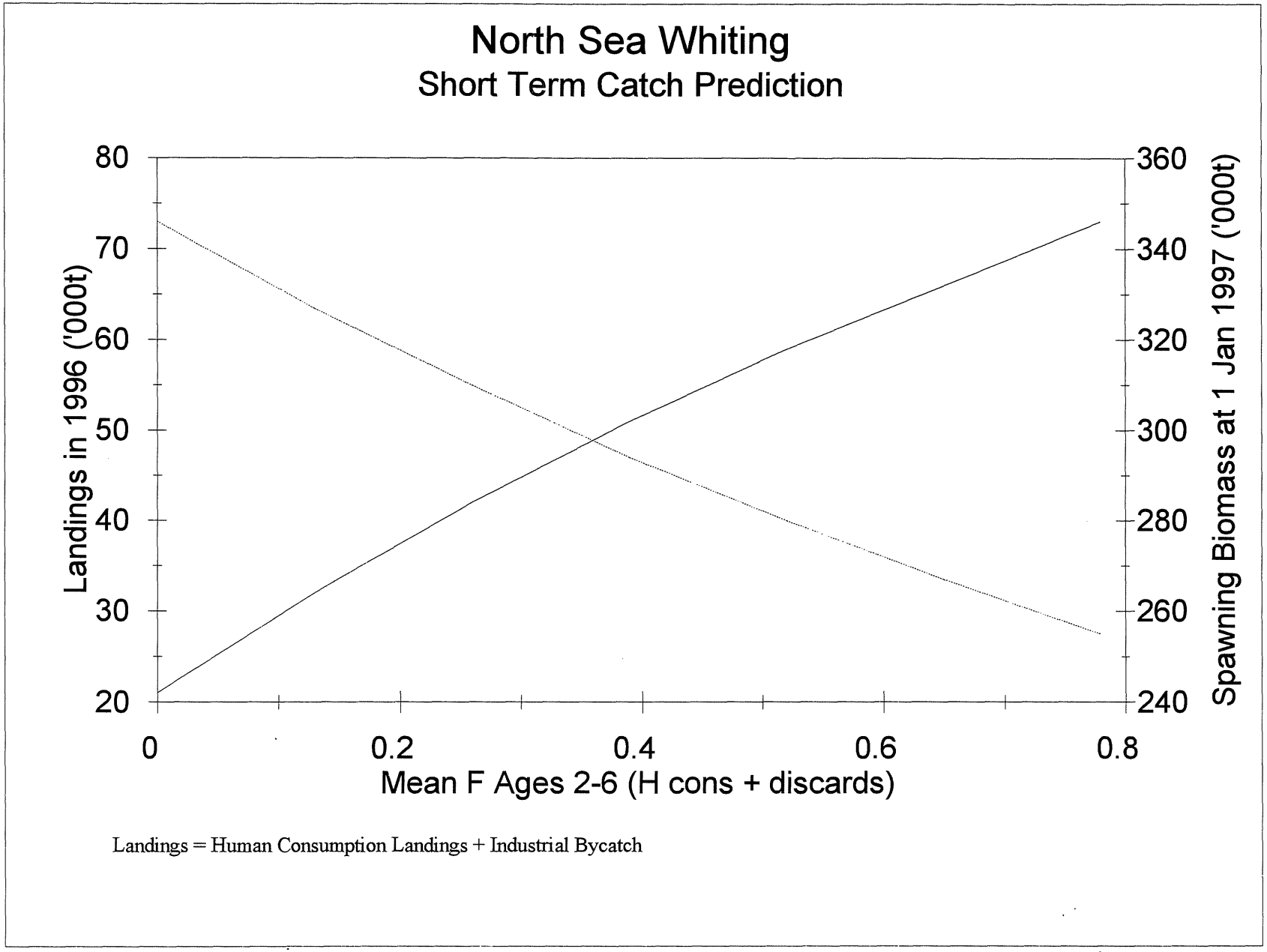

North Sea Whiting
Short Term Catch Prediction
Landings in 1996 ('000t)
Spawning Biomass at 1 Jan 1997 ('000t)
80
70
60
50
40
30
20
360
340
320
300
280
260
240
0
0.2
0.4
0.6
0.8
Mean F Ages 2-6 (H cons + discards)
Landings = Human Consumption Landings + Industrial Bycatch

Figure 3.4.8 North Sea Whiting
Sensitivity analysis of short-term forecast. Linear sensitivity coefficients (elasticities). Key to labels in Table 3.3.14

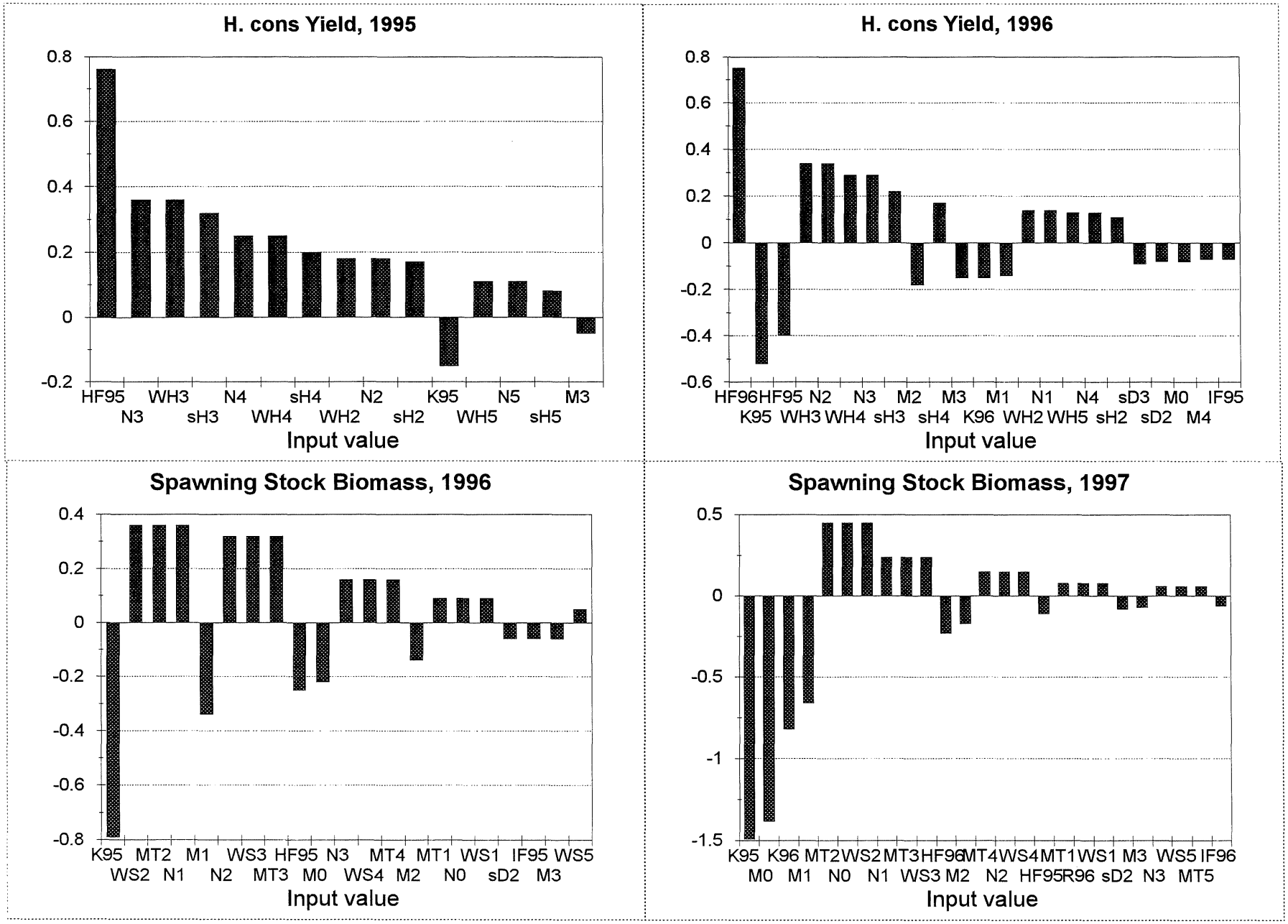


Figure 3.4.9 North Sea Whiting
Sensitivity analysis of short-term forecast. Proportion of total variance contributed by each input value. Key to labels in Table 3.3.14

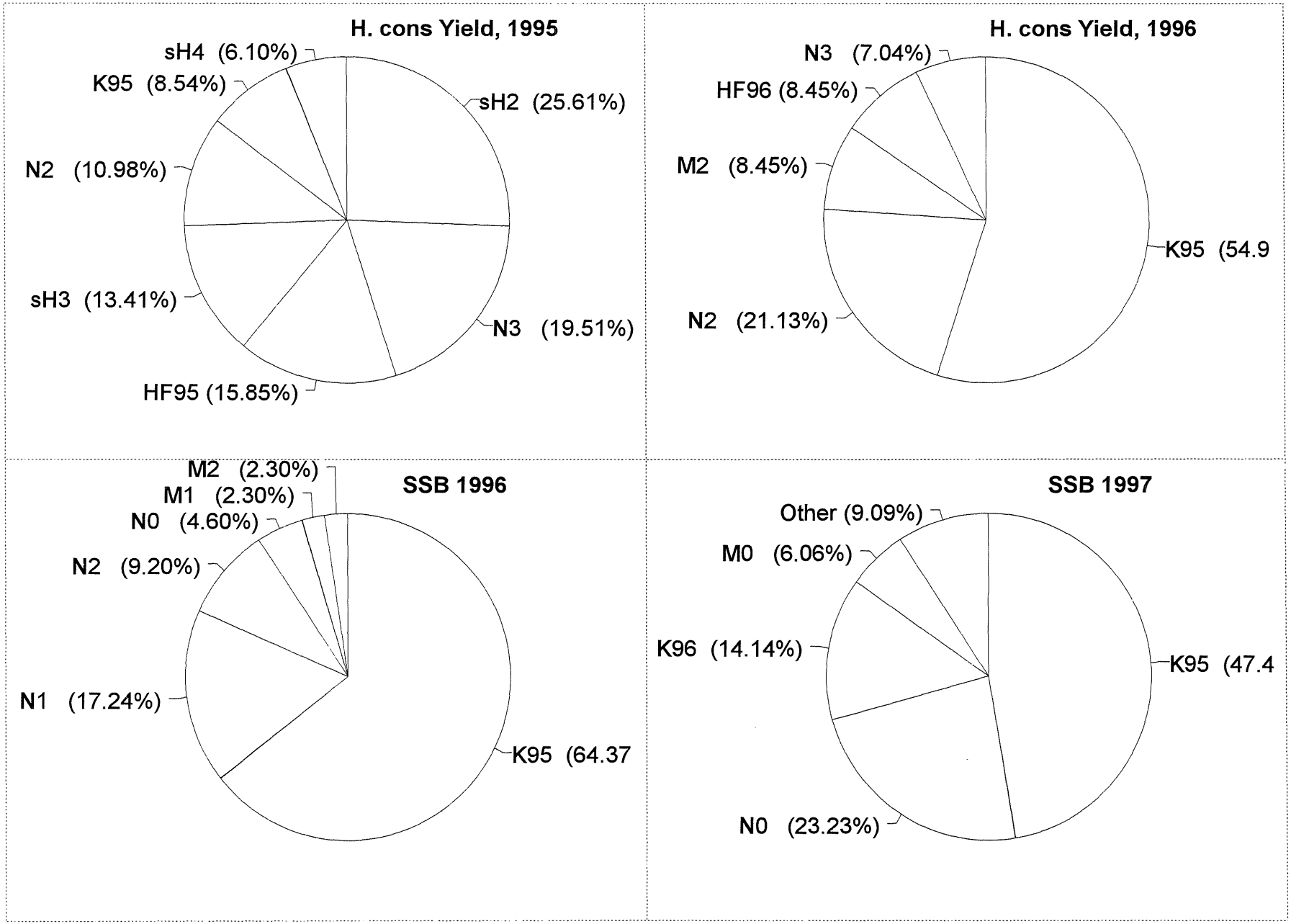


Figure 3.4.10 North Sea Whiting
Sensitivity analysis of short-term forecast. Cumulative probability distributions.

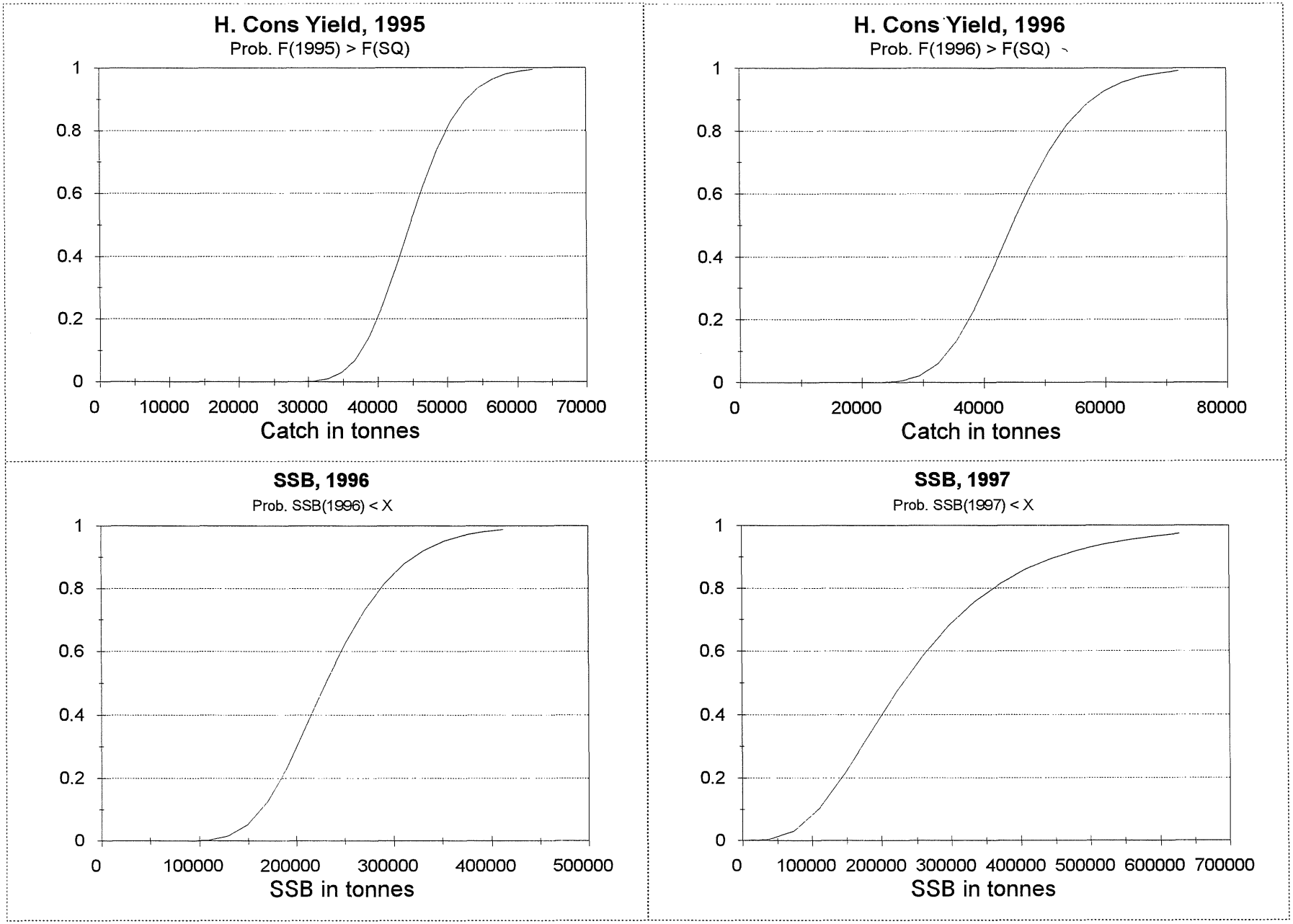
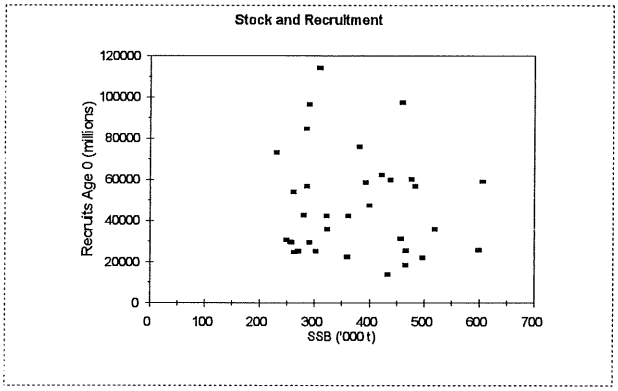


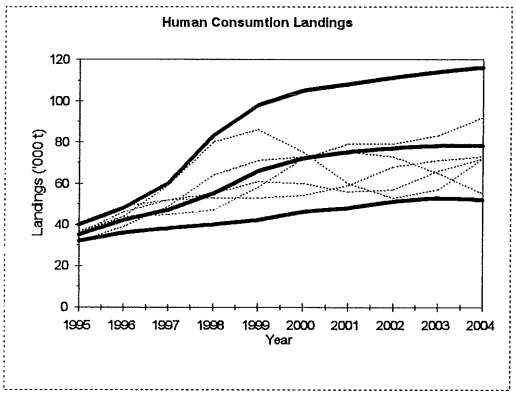
Figure 3.4.11

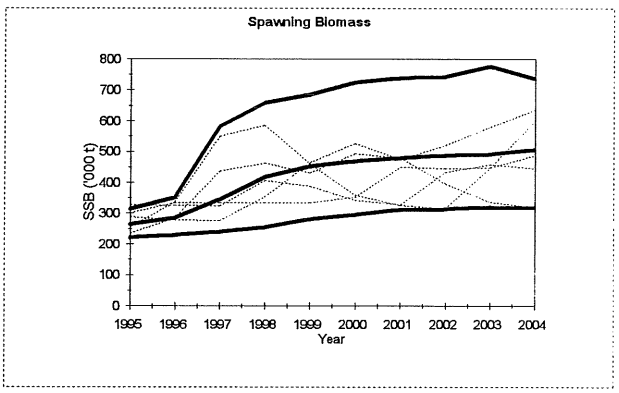
North Sea Whiting. Medium term predictions relative to status quo F (H cons + Discards)

Solid lines are 5, 50 and 95 percentiles, dashed lines are 5 realisations of the simulation

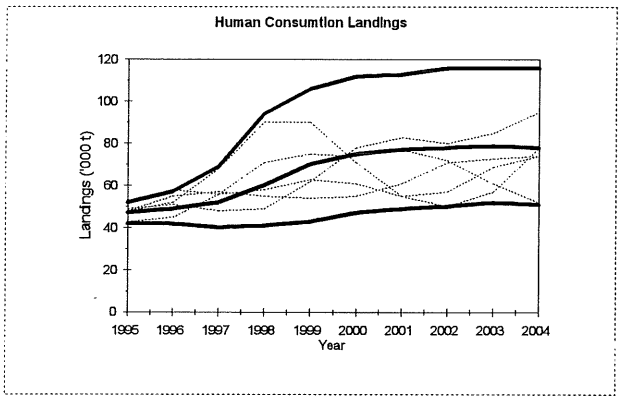


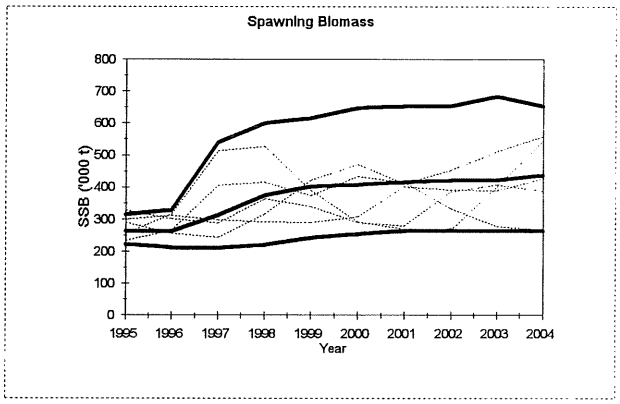
Effort reduction to 70% of SQ F



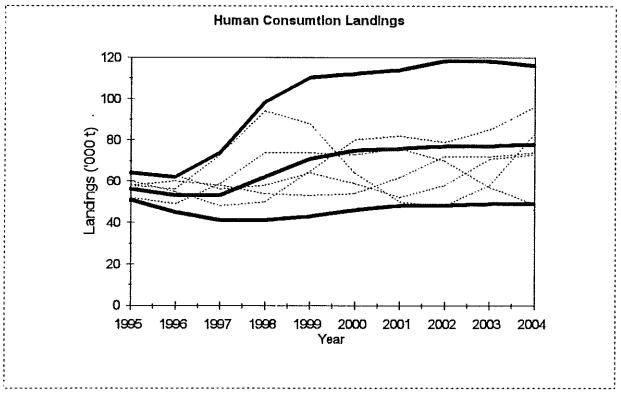


Status quo F





Effort increase to 130% status quo F



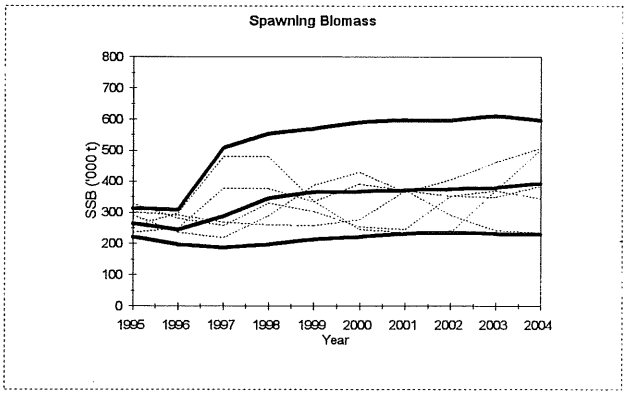
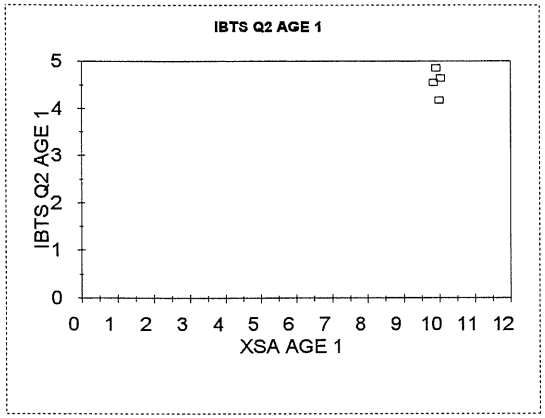
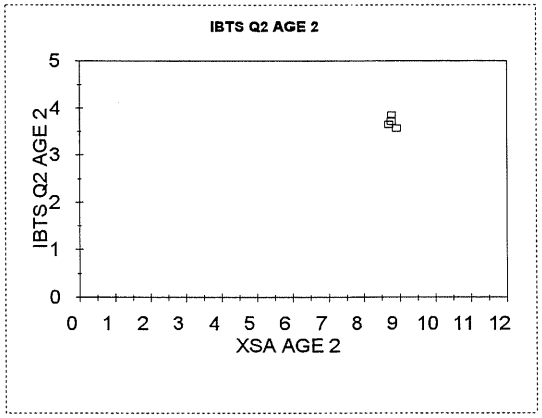
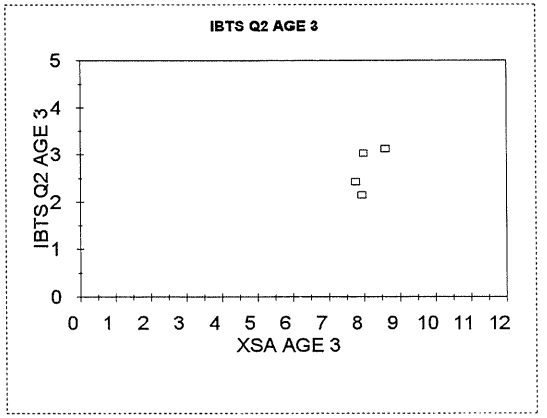


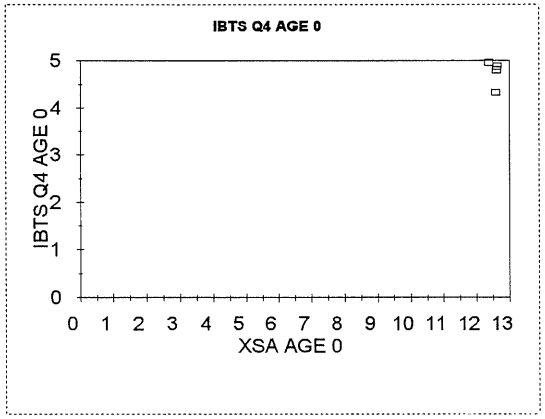
Figure 3.4.12

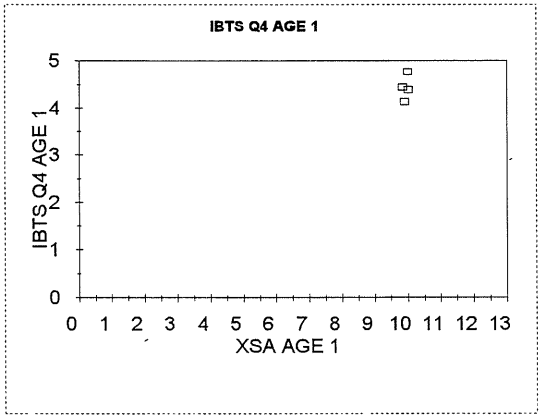
North Sea whiting. IBTS Q2 and Q4 log indices Vs XSA log abundance











3.5 Saithe in Sub-area IV and Division IIIa

3.5.1 Catch trends

Recent nominal landings are given in Table 3.5.1. Working Group estimates are in Table 3.5.2 and are plotted in Figure 3.5.1. Landings were high in the early 1970s, reaching a maximum of 320,000 t in 1976. Subsequently, landings declined to 114,000 t in 1979, mainly due to the discontinuation in the fishery of the USSR. After that, the landings followed an increasing trend to reach 200,000 t in 1985. This increase corresponds to good year classes coming into the fishery. However, low cod quotas in the Barents Sea added extra fishing pressure to the saithe in the North Sea, especially from Norwegian trawlers. Since then, the cod stock in the Barents Sea has increased and Norwegian fishing effort for saithe in the North Sea has dropped. Since 1985 the saithe landings have decreased considerably. In 1993 and 1994, the landings are estimated to be 105,000 t and 97,000 t respectively. Small amounts of saithe are taken as industrial by-catch, but most of the saithe is sorted out and delivered for human consumption. Since 1977, the average industrial by-catch has been 2,400 t, and in 1994 no bycatch was registrated (Table 13.5.2). The agreed TAC in 1994 was 97,000 t which is equal to the catch.

In 1994 The working group estimated unreported landings to be about 6,600 t, but this is counterbalanced by the officially reported landings being very preliminary, and that they also contain catches from other Divisions.

Saithe is mainly taken in a directed trawl fishery which started in the beginning of the 1970s. The French, German and Norwegian catches make up about 80 % of the total international catch.

3.5.2 Natural mortality, maturity, age compositions, mean weight at age

Conventional values of natural mortality rate and maturity at age based on biological sampling are given in Table 3.5.3. They are unchanged from those used last year. Total international age compositions are given in Table 3.5.4. Data for 1993 were updated with minor changes. Data for 1994 were supplied by Denmark, Germany, France, Norway, UK (England) and UK (Scotland) amounting to 92 % of the catches. Discards are not included. These are thought to be small, but there is reported significant discard from some nations. This may be a problem with allocation of quotas.

The mean weights at age in the landings are given in Table 3.5.5. These are also used as stock mean weights. SOP corrections have not been applied.

3.5.3 Catch, effort and research vessel data

Commercial catch and effort data used to tune the VPA are shown in Table 3.5.6. Scottish and English research vessel indices of abundance for saithe, and a series of 0-group indices estimated by observers are shown in Table 3.5.10. The data from the French trawlers starts in 1978 and contains the age groups 2 - 10. This fleet consists of three components. The main component is the Boulogne fleet which amounts to about two thirds of total effort. This fleet has been relatively stable in recent years. For the other two components we do not have any data for 1994. The Lorient fleet amounted to about 35 % of the catch in 1992 and 1993, but the effort has decreased drastically from 1991 to 1993. The same can be said for the fleet in Concarneau. This fleet amounts to only a few per cent of total catch. We thus lack information of about one third of the French trawlers in 1994. The Working Group has supposed that these fleets represent about 35 % of the French catch and added that to the total international catch, but nothing was done with the tuning file. The data from the Norwegian trawlers starts in 1980 and contains the age groups 1 - 10. After the drop in effort in the period 1985 to 1990, the effort in recent years seems to have stabilised on half the level of 1985.

Industrial by-catches are now very small and it is not necessary to analyse those catches as a separate category. The present analysis consists therefore of only one category.

3.5.4 Catch-at-age analysis

Preliminary tunings were done including and excluding Scottish light trawl data. Including these data did not improve the assessment. Scottish light trawl got very low weight in the tuning, and the retrospective analysis with these data included (Figure. 3.5.13) did not perform as good as the VPAs with French and Norwegian data only (Figure 3.5.3). It was therefore decided to run the tuning without Scottish light trawl data. The method used to tune the VPA was XSA (v3.1), the same method as was used last year. Tuning was done over a 17 years period, with shrinkage of 0.5 and a tricubic time taper. Inspection of preliminary retrospective runs indicated that the VPA performed best when the ages 1, 2 and 3 were treated as recruiting ages, as last year. Catchability was fixed for ages 7 and above. The age range used for VPA was 1 to 10 (the plus group), and F for the oldest ages was shrunk to the mean of the 5 younger ages. The tuning results are given in Table 3.5.7. and the residuals of the log catchability are plotted in Figure 3.5.2. Table 3.5.8 gives the values of fishing mortality rates, and Table 3.5.9 gives the stock numbers estimated by tuning. For the ages 4 to 6 the mean shrinker gets the same weights as each of the two fleets, while it get higher weight for the two older ages. For the recruiting ages the F shrinkage mean and the P shrinkage mean are sharing the weights equally. The F shrinkage mean gives much

lower numbers than the P shrinkage mean (see section 3.5.12).

A retrospective analysis was run for six years backwards. The results are plotted in Figure 3.5.3. There is reasonable agreement for all runs. Except for the 1991 and 1992 runs it seems to be a tendency to overestimate spawning stock and underestimate fishing mortality.

3.5.5 Recruitment Estimates

The research vessel indices used in the RCT3 program for estimating recruitment are given in Table 3.5.10 and plotted in Figure 3.5.4. The results of the RCT3 analysis are given in Table 3.5.11 and Table 3.5.12. They were used as estimates for ages 1 and 2 in 1995 (year classes 1994 and 1993). The year class 1994 was estimated to 245 million at age 1, and the year class 1993 was estimated to 167 million at age 2. We have one preliminary index for the year class 1995, and the estimate of this year class was 253 millions. For the year class 1997 the geometric mean of 206 millions was used. The VPA mean and the NORW0 were equally sharing the weights in the RCT3 analysis. SGFS2 was given some weight for the 1993 year class.

3.5.6 Historical stock trends

Table 3.5.13 gives a summary of the trends in fishing mortality, biomass and recruitment as estimated by VPA. These data are also plotted in Figure 3.5.1.

Mean fishing mortality increased substantially from 1981 to 1986. Since then, it has decreased to a level of about 0.45. Total biomass and spawning biomass show a continuous downwards trend until 1990 when they were on historically low levels, but the present assessment shows some improvement of the stock.

3.5.7 Biological reference points

Yield and biomass per recruit are shown in Figure 3.5.6, and input data are in Table 3.5.14. A stock/recruitment plot is shown in Figure 3.5.5. F_{high} (0.74) and F_{med} (0.47) replacement lines are shown in Figure 3.5.5. *Status quo* F is now very close to F_{med}, and stock replacement will in the long term be sustained with average recruitment. F_{max} is 0.22 and $F(_{0.1})$ is 0.125.

3.5.8 Short term forecast

Input data for prediction are given in Table 3.5.14. Ages 1 and 2 are estimated from RCT3. The period for calculations of mean exploitation pattern and mean weights is 1990 to 1994. The 1995 year class is estimated by RCT3 while geometric mean is used for the 1996 year class. Results of the prediction are given in Table 3.5.15, and in Figure 3.5.7. Input data for a sensitivity analysis (see Section 1.3.1) are shown in Table 3.5.16 and the results of this analysis are shown in Figures 3.5.8 - 3.5.10.

Maintenance of the 1994 level of fishing mortality in 1995 will lead to landings of 105,000 t in 1995 and 111,000 t in 1996. Spawning stock size is predicted to increase to 150,000 t.

The sensitivity analysis shows that the prediction of the yield in 1996 is dependent of the fishing mortality levels in 1995 and 1996 together with the numbers of the ages 2, 3 and 4, and the weights of the ages 3 to 6. Natural mortality in 1995 is also of importance. The prediction of the spawning stock in 1997 is dependent of the fishing mortality levels in 1995 and 1996 together with the numbers of the ages 3 to 5, the weights of the ages 5 to 7, the proportion mature at age 7 and 5, the stock weights at age 7 and 5, the relative fishing mortalities of the ages 4 to 6 and the natural mortality in 1995 and 1996 (Figure 3.5.8). The fishing mortality level in 1995 and 1996 and stock numbers of ages 3 to 5 contributes to most of the variance in the prediction (Figure 3.5.9).

The probability plots show that there is about a 5 % probability that the spawning stock will drop below 100,000 t in 1997 if the current level of fishing mortality is maintained (Figure 3.5.10), and with a catch of 111,000 t in 1996 there is about a 60% probability that fishing mortality will be higher than in 1995.

The predicted *status quo* catch for 1995 of 105,000 t was so close to the TAC of 107,000 t that no prediction with TAC constraint was run.

3.5.9 Medium term projections

The input for these analyses (see Section 1.3.2) are shown in Table 3.5.16 and Table 3.5.17, and the results are presented in Figure 3.5.11 and 3.5.12. Assuming a Beverton-Holt stock-recruitment relationship (Figure 3.5.11) and the present low fishing mortality, the median landings will increase and stabilise at about 150,000 t. The median spawning stock biomass will increase and reach about 200,000 t, and the probability for SSB to fall below 150,000t is about 5 %. However, fishing mortality seems to be underestimated in recent years. Both in 1994 and 1993 the fishing mortality was underestimated with about 15 %. A run where *status quo* fishing mortality was adjusted with 15 % was therefore done. This run shows that the landings will stabilise around 120,000 t, and that there may be a probability of 5 % that SSB can fall below 110,000 t (Figure 3.5.12). If fishing mortality were increased further with 10 % there was a 5 % probability that SSB would fall below 95,000 t.

3.5.10 Long term Considerations

The current level of F is at F_{med}, which implies that average recruitment is required to sustain spawning stock biomass. However, with *status quo* exploitation, the

medium term projection indicates that the probability of reaching a spawning stock biomass on the level seen in the 1970s is small.

3.5.11 Comments on the Assessment

Tables 3.5.18 shows the quality control sheets. This year's assessment is consistent with the assessment last year, but fishing mortality seems to be underestimated in the most recent years. The inclusion of recruitment data seems to have improved the assessment. However, the F shrinkage mean is given a height weight in the tuning. This high weights create problems in the tuning of the recruiting ages. The F shrinkage mean for age 1 estimate the survivors to be 14 millions while the P shrinkage mean estimate 154 millions. The estimated number of age 1 is thus driven much downwards by the F shrinker. For age 2 and 3 the problem also exist, but it is not so pronounced. The F shrinkage mean gives the values 85 millions and 34 millions for ages 2 and 3 while the P shrinkage mean gives 115 millions and 67 millions. In the RCT3 analysis average recruitment gets a high weight. Because of the great influence of the mean, the forecast should be treated with caution.

3.5.12 Evaluation of the usefulness of quarterly IBTS in the assessment

There were no IBTS data for saithe ready for this assessment.

Table 3.5.1 Nominal catch (in tonnes) of Saithe in Sub-area IV and Division IIIa, 1983-1994, as officially reported to ICES.

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	7	32	31	16	4	60	13	23	29	70	113	130
Denmark	10,530	8,526	9,033	10,343	7,928	6,868	6,550	5,800	6,314	4,669	4,232	4,305[1]
Faroe Islands	806	-	895	224	691	276	739	1,650	671	2,480	2,875	1,780[1]
France	38,782	43,592	42,200	43,958	38,356	28,913	30,761[1,2]	29,892[1,2]	14,795[1,2]	9,061[1]	22,615[1,2]	18,220[1,2]
Germany	13,649	25,262	22,551	22,277	22,400	18,528	14,339	15,006	19,574	13,177	14,813[1]	10,013
Netherlands	89	181	233	134	334	345	257	206	199	180	79	18
Norway	81,330	88,420	101,808	67,341	66,400	40,021	24,737	19,122	36,240	48,205	48,725[1]	50,282[1]
Poland	415	413	-	495	832	1,016	809	1,244	1,336	1,238	937[1]	151
Sweden	548	522	1,764	1,987	1,732	2,064	797	838	1,514	3,302	4,955	5,366
UK (Engl.& Wales)	6,845	8,183	5,455	4,480	3,233	3,790	4,441	3,654	4,709	3,158	2,426	2,354
UK (N. Ireland)	-	-	-	-	-	-	24	-	-	2	3	1
UK (Scotland)	6,321	6,970	9,932	15,520	11,911	10,850	8,726	7,383	7,962	6,593	5,913	5,562
USSR	-	-	-	-	-	-	-	-	116[3]	-	-	-
Total reported to ICES	159,322	182,101	193,902	166,775	153,821	112,731	92,193	84,818	93,459	92,135	107,705	98,182
Unreported landings	9,562	15,900	5,839	-2,459	-4,627	-7,630	-200	3,257	5,464	371	-3,106	-1,012
Landings as used by WG	168,884	198,001	199,741	164,297	149,194	105,101	91,993	88,075	98,923	92,506	104,599	97,170

[1]Preliminary.
[2]Includes IIa(EC), IIIa-d(EC).
[3]Includes Estonia.
n/a = not available.

TABLE 3.5.2 Saithe, North Sea
Annual weight and numbers caught, 1970 to 1994.

Year	Wt.('000 t)			Nos.(millions)		
	Total	H. con	Ind BC	Total	H. con	Ind BC
1970	222	163	59	146	95	51
1971	253	218	35	178	144	35
1972	246	218	28	179	154	25
1973	226	195	31	172	143	30
1974	273	231	42	166	121	45
1975	278	240	38	190	142	48
1976	320	253	67	236	224	11
1977	196	190	6	122	117	5
1978	135	132	3	99	97	2
1979	114	113	2	68	67	1
1980	120	120	0	73	72	0
1981	123	121	1	71	69	2
1982	166	161	5	115	110	5
1983	169	167	1	112	111	1
1984	198	192	6	168	162	6
1985	200	192	8	207	195	11
1986	164	163	1	159	157	2
1987	149	145	4	166	159	7
1988	105	104	1	94	93	1
1989	92	90	2	78	75	3
1990	88	86	2	63	58	5
1991	99	98	1	96	95	1
1992	93	92	0	70	70	0
1993	105	104	1	79	77	2
1994	97	97	0	76	73	0

TABLE 3.5.3 Saithe, North Sea
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.200	.000
2	.200	.000
3	.200	.000
4	.200	.150
5	.200	.700
6	.200	.900
7	.200	1.000
8	.200	1.000
9	.200	1.000
10+	.200	1.000

TABLE 3.5.4 Saithe, North Sea
International catch at age ('000), Total , 1970 to 1994.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	234	669	387	4420	3988	314	240	2036	1237	938
2	2251	11161	20672	31490	16390	72334	22587	12943	16948	16815
3	35813	69382	40971	48840	61811	51167	136608	23022	31381	14492
4	77623	54194	63934	34257	31664	23572	47633	52642	25689	13014
5	13194	30964	23249	25175	12154	9029	9935	13100	17067	10029
6	11529	3676	20859	15343	20132	6718	5165	4761	2650	7992
7	3654	3810	3385	8038	13774	12672	3333	3221	856	2438
8	1596	2496	2806	1696	4320	8664	4873	3065	798	578
9	278	1589	1562	1172	993	3311	3026	3528	613	350
10+	144	545	1469	1934	1106	2353	2141	3792	2202	1336

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	1299	5320	1945	274	59	215	107	799	11	4194
2	23329	18497	28637	32898	34563	6712	6171	28942	4943	9171
3	14147	22382	27581	23482	75559	124467	47409	28971	27542	14579
4	11394	6371	39122	18051	29818	54500	85165	90034	23240	25919
5	8352	6165	7947	25232	12107	13064	12186	12462	32511	11608
6	6100	3272	5421	4916	12369	4060	4270	1951	2923	9884
7	5206	3000	1767	4387	1363	2542	1591	1126	1138	1274
8	959	3178	1217	1336	1120	464	1048	816	456	539
9	420	505	851	932	282	270	262	691	496	294
10+	1508	1873	803	825	494	258	480	500	395	323

Age	1990	1991	1992	1993	1994
1	291	363	293	143	97
2	3267	12364	5482	6842	6297
3	30215	44155	16387	34202	15427
4	13575	27214	30397	18257	36438
5	9091	6475	11844	11275	11800
6	3709	2970	2826	3008	3810
7	2078	1304	1410	1521	808
8	487	725	633	1507	267
9	144	282	460	801	378
10+	182	204	311	965	662

TABLE 3.5.5 Saithe, North Sea
International mean weight at age (kg), Total catch, 1970 to 1994.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.470	.495	.309	.154	.275	.200	.450	.444	.356	.435
2	.744	.666	.517	.397	.506	.483	.497	.425	.530	.390
3	.952	.946	.773	.806	.850	.835	.685	.753	.809	1.083
4	1.475	1.521	1.232	1.478	1.550	1.420	1.416	1.324	1.325	1.597
5	2.150	2.577	2.103	1.729	2.322	2.274	2.367	2.014	2.147	2.227
6	2.810	3.475	2.617	2.806	2.719	2.988	3.283	3.199	3.246	3.079
7	3.750	4.426	4.248	3.662	3.444	3.451	4.301	4.299	4.502	3.980
8	4.640	5.406	4.644	5.126	4.407	3.963	4.651	4.798	4.819	5.147
9	6.020	6.004	4.979	4.959	5.595	5.223	5.346	5.227	5.361	5.960
10+	7.164	6.516	6.695	6.675	7.461	7.043	7.184	6.773	6.769	7.177

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.259	.274	.251	.394	.182	.143	.482	.363	.425	.418
2	.412	.586	.500	.452	.482	.487	.482	.387	.554	.674
3	.895	.936	1.086	.969	.773	.671	.663	.652	.725	.860
4	1.782	1.840	1.567	1.687	1.603	1.315	1.026	.861	.946	1.023
5	2.328	2.642	2.499	2.101	2.277	1.983	1.723	1.783	1.389	1.434
6	2.929	3.438	3.145	3.032	2.653	2.725	2.317	2.952	2.790	1.965
7	4.005	4.417	3.969	3.499	3.737	3.232	3.577	3.781	3.847	3.881
8	4.988	5.392	4.919	4.400	4.548	4.587	4.259	4.876	4.817	4.875
9	5.749	6.872	5.622	5.293	5.940	5.216	5.776	5.447	5.792	6.350
10+	7.224	8.284	7.779	6.852	7.757	7.333	7.892	6.996	7.240	8.592

Age	1990	1991	1992	1993	1994
1	.215	.441	.625	.324	.271
2	.606	.501	.570	.645	.671
3	.816	.782	.949	.885	.882
4	1.202	1.160	1.191	1.306	1.097
5	1.605	1.761	1.610	1.827	1.565
6	2.311	2.416	2.239	2.718	2.374
7	3.290	3.257	3.703	3.222	3.547
8	4.710	4.200	4.363	4.357	4.673
9	6.209	5.966	5.403	5.091	6.575
10+	8.390	7.337	6.207	6.782	8.227

Table 3.5.5a Saithe North Sea.
Sum of products correction

Year	SOP	Year	SOP
1970	0.9453	1983	1.0058
1971	0.8656	1984	0.9952
1972	0.9115	1985	0.9553
1973	0.9155	1986	0.9769
1974	0.9971	1987	0.9855
1975	1.0546	1988	0.9527
1976	1.1370	1989	0.9656
1977	0.9444	1990	1.1332
1978	0.9632	1991	0.9746
1979	0.9968	1992	0.9962
1980	1.0094	1993	0.9558
1981	1.0052	1994	0.9973
1982	0.9939		

TABLE 3.5.6 Tuning input data for saithe in IV

```
NORTH SEA SAITHE : 1960-1994 : INCLUDES IND. BYCATCH : 31/8/95 : Not SoP corrected
102
FRATRB
    1978    1994
       1       1    .000   1.000
       2      10
   69739.000     248.000    1853.000    3183.000    5447.000     762.000     190.000     154.000     122.000     163.000
   89974.000     230.000    4525.000    3618.000    4128.000    2809.000     329.000      87.000      51.000      84.000
   63577.000     528.000    3149.000    4450.000    2322.000    1412.000     746.000     104.000      45.000      29.000
   76517.000    4538.000    9067.000    2893.000    2423.000     939.000     456.000     258.000      36.000      48.000
   78523.000    1285.000    6001.000   10009.000    2630.000    1328.000     543.000     164.000      98.000      21.000
   69720.000     799.000    3487.000    5770.000    8617.000    1183.000     270.000      86.000      37.000      29.000
   76149.000    1311.000    5482.000    8632.000    5121.000    3837.000     232.000     155.000      33.000      49.000
   53003.000     810.000    8447.000   10230.000    3677.000    1194.000     596.000      33.000      40.000      18.000
   50350.000     721.000    4648.000   12454.000    3291.000    1124.000     291.000     213.000      33.000      15.000
   51234.000     873.000    2062.000   11802.000    3537.000     566.000     268.000     104.000      76.000      20.000
   35482.000     451.000    2038.000    2263.000    7860.000     723.000     178.000      54.000      33.000      37.000
   36133.000     553.077    3197.885    5199.979    2726.086    2846.718     143.775      37.077      13.706      11.566
   36097.000     475.076    4783.261    4360.992    2555.746     525.267     495.450      67.964      31.461      16.020
   45075.000     458.002    2493.662    5483.608    1560.596     673.786     230.058     136.771      26.868      13.350
   34138.000     385.622    1302.925    3058.332    1080.604     153.874      57.665      24.037      18.272       5.552
   23721.000     747.315    4474.987    3433.931    2062.051     216.138      30.675      20.028      15.276      16.720
   17316.000     434.284    1954.025    4092.962    1605.895     521.769      58.566       8.602       4.793       5.176
NORTRL
    1980    1994
       1       1    .000   1.000
       1      10
   18317.000        .000        .000     186.000    1290.000     658.000     980.000     797.000     261.000      60.000      82.000
   28229.000        .000       2.000      88.000     844.000    1345.000     492.000     670.000     699.000     119.000      64.000
   47412.000       1.000    1481.000    6624.000   12016.000    2737.000    2112.000     341.000     234.000      19.000      77.000
   43099.000        .000    1712.000    4401.000    4963.000    8176.000    1950.000    2367.000     481.000     357.000      84.000
   47803.000        .000    5742.000   20576.000    7328.000    2207.000    3358.000     433.000     444.000     106.000      51.000
   66607.000        .000    1156.000   27088.000   21401.000    5307.000    1569.000     637.000      56.000      46.000       4.000
   57468.000        .000      26.000    5297.000   29612.000    3589.000     818.000     393.000     122.000      25.000      33.000
   30008.000        .000     199.000    2645.000   18454.000    2217.000     290.000     235.000     201.000     198.000      64.000
   18402.000        .000     161.000    3132.000    2042.000    2214.000     141.000     157.000      74.000     134.000      43.000
   17781.000        .000        .000     649.000    2126.000     835.000     694.000     309.000     154.000      65.000       7.000
   10249.000        .000       9.000     804.000     781.000     924.000     519.000     203.000      63.000      12.000       3.000
   28768.000      29.000    1264.000   14348.000    4968.000    1194.000     518.000     203.000      51.000      56.000       1.000
   35621.000        .000     217.000    3447.000    9532.000    4031.000    1087.000     465.000     165.000     109.000       6.000
   24572.000      10.000     455.000    7635.000    4028.000    2878.000    1018.000     526.000     365.000     252.000     252.000
   28389.000      51.000     457.000    3475.000   15072.000    3961.000     835.000     223.000      61.000     182.000      18.000
```

Table 3.5.7 Tuning diagnostics for saithe in IV

Lowestoft VPA Version 3.1

2/10/1995 16:18

Extended Survivors Analysis

NORTH SEA SAITHE : 1970-1994 : INCLUDES IND. BYCATCH : 31/8/95

CPUE data from file SAIIVEF.tun

Catch data for 25 years. 1970 to 1994. Ages 1 to 10.

Fleet,	First year,	Last year,	First age ,	Last age	Alpha,	Beta
FRATRB	1978,	1994,	2,	9,	.000,	1.000
NORTRL	1980,	1994,	1,	9,	.000,	1.000

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 4

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 4

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 15 iterations

Regression weights
, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

Log catchability residuals.

Fleet : FRATRB

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
2,	-28.61,	-2.856,	******,	.00,	17,	15.12,	-15.98,
3,	1.91,	-1.511,	15.99,	.22,	17,	.95,	-13.93,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
4,	1.08,	-.274,	12.89,	.54,	17,	.46,	-12.76,
5,	.80,	.840,	11.94,	.64,	17,	.29,	-12.39,
6,	.69,	1.210,	11.63,	.60,	17,	.35,	-12.74,
7,	1.39,	-.665,	15.26,	.22,	17,	.85,	-13.29,
8,	1.34,	-.806,	15.74,	.36,	17,	.73,	-13.66,
9,	3.17,	-2.425,	28.71,	.11,	17,	1.43,	-13.66,

Table 3.5.7 continued
Fleet : NORTRL
Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
1,	-.65,	-1.631,	7.12,	.40,	4,	1.10,	-19.41,
2,	.88,	.105,	16.03,	.08,	13,	1.64,	-16.60,
3,	.91,	.142,	13.35,	.20,	15,	1.00,	-13.52,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
4,	.60,	3.098,	11.84,	.86,	15,	.20,	-12.33,
5,	1.16,	-.405,	12.54,	.40,	15,	.47,	-12.21,
6,	.99,	.030,	12.31,	.33,	15,	.59,	-12.35,
7,	1.72,	-.914,	15.16,	.14,	15,	1.12,	-12.26,
8,	1.31,	-.458,	13.92,	.19,	15,	1.16,	-12.41,
9,	.81,	.406,	11.11,	.31,	15,	.75,	-12.16,

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB ,	1,	.000,	.000,	.00,	0, .000,	.000
NORTRL ,	437209,	2.478,	.000,	.00,	1, .017,	.000
P shrinkage mean ,	154034,	.44,,,,			.555,	.001
F shrinkage mean ,	14167,	.50,,,,			.428,	.006

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
56484,	.33,	1.68,	3,	5.133,	.002

Age 2 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB ,	0,	16.317,	.000,	.00,	1, .000,	.000
NORTRL ,	152074,	1.418,	.476,	.34,	2, .053,	.037
P shrinkage mean ,	115871,	.48,,,,			.495,	.048
F shrinkage mean ,	85207,	.50,,,,			.451,	.065

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
101781,	.34,	.23,	5,	.674,	.054

Age 3 Catchability dependent on age and year class strength

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB ,	124388,	.998,	1.180,	1.18,	2, .078,	.106
NORTRL ,	88411,	.893,	.326,	.37,	2, .096,	.147
P shrinkage mean ,	67064,	.47,,,,			.437,	.189
F shrinkage mean ,	33956,	.50,,,,			.389,	.344

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
55446,	.31,	.37,	6,	1.208,	.225

Table 3.5.7 continued

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB	65830,	.395,	.285,	.72,	3, .345,	.406
NORTRL	80674,	.416,	.128,	.31,	4, .304,	.343
F shrinkage mean	34343,	.50,,,,			.351,	.673

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
55730,	.26,	.20,	8,	.772,	.465

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB	14492,	.277,	.172,	.62,	4, .406,	.552
NORTRL	16361,	.301,	.155,	.51,	4, .338,	.502
F shrinkage mean	9305,	.50,,,,			.256,	.764

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
13478,	.20,	.13,	9,	.634,	.583

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB	5941,	.277,	.123,	.44,	5, .382,	.458
NORTRL	5975,	.305,	.151,	.49,	5, .314,	.456
F shrinkage mean	3220,	.50,,,,			.304,	.728

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
4940,	.21,	.13,	11,	.619,	.529

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
FRATRB	1056,	.326,	.134,	.41,	6, .333,	.526
NORTRL	1594,	.360,	.192,	.53,	5, .276,	.377
F shrinkage mean	794,	.50,,,,			.391,	.653

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1058,	.24,	.13,	12,	.527,	.525

Table 3.5.7 continued

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRB	179,	.372,	.140,	.38,	7,	.283,	.853
NORTRL	372,	.415,	.214,	.52,	7,	.199,	.501
F shrinkage mean	276,	.50,,,,				.517,	.629

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
259,	.29,	.11,	15,	.366,	.659

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FRATRB	137,	.334,	.211,	.63,	8,	.297,	1.254
NORTRL	448,	.381,	.214,	.56,	8,	.200,	.567
F shrinkage mean	459,	.50,,,,				.503,	.557

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
318,	.28,	.19,	17,	.687,	.729

TABLE 3.5.8 Saithe, North Sea
International F at age, Total , 1970 to 1994.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.001	.003	.002	.019	.008	.002	.002	.018	.013	.004
2	.007	.066	.129	.193	.088	.200	.177	.132	.202	.250
3	.161	.280	.364	.508	.717	.433	.717	.276	.544	.267
4	.522	.391	.452	.594	.742	.670	.959	.680	.569	.455
5	.547	.406	.289	.322	.433	.483	.676	.778	.488	.455
6	.568	.285	.532	.314	.463	.455	.568	.832	.344	.445
7	.327	.369	.462	.401	.519	.603	.430	.874	.336	.617
8	.227	.390	.513	.446	.392	.740	.492	.924	.549	.399
9	.441	.370	.453	.418	.514	.595	.631	.826	.464	.497
10+	.441	.370	.453	.418	.514	.595	.631	.826	.464	.497

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.009	.030	.007	.001	.000	.002	.001	.010	.000	.024
2	.125	.166	.226	.148	.104	.023	.054	.239	.077	.079
3	.346	.170	.398	.292	.592	.656	.227	.388	.376	.338
4	.348	.258	.503	.496	.747	1.244	1.492	.894	.624	.745
5	.601	.321	.594	.724	.745	.902	1.122	.956	1.014	.752
6	.559	.502	.522	.948	1.012	.604	.878	.519	.614	1.056
7	.591	.598	.562	1.133	.767	.579	.506	.603	.663	.600
8	.528	.918	.520	1.193	1.067	.652	.502	.533	.527	.786
9	.571	.593	.678	1.016	.900	.823	1.007	.747	.737	.789
10+	.571	.593	.678	1.016	.900	.823	1.007	.747	.737	.789

Age	1990	1991	1992	1993	1994
1	.002	.002	.002	.001	.002
2	.023	.121	.029	.071	.054
3	.403	.484	.234	.251	.225
4	.611	.791	.743	.445	.465
5	.642	.674	1.025	.691	.583
6	.575	.445	.719	.809	.529
7	.657	.406	.393	1.178	.525
8	.483	.504	.352	.990	.659
9	.496	.581	.710	1.057	.729
10+	.496	.581	.710	1.057	.729

TABLE 3.5.9 Saithe, North Sea
Tuned Stock Numbers at age (10**-3), 1970 to 1995, (numbers in 1995 are VPA survivors)

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	236932	230941	242066	266895	542082	187974	141131	127160	103871	268647
2	385839	193772	188473	197836	214516	440211	153616	115331	102268	83924
3	265603	313861	148548	135604	133481	160800	294964	105333	82714	68395
4	210959	185052	194188	84549	66830	53356	85354	117888	65408	39325
5	34620	102483	102471	101138	38226	26065	22355	26782	48886	30307
6	29413	16406	55888	62860	60026	20300	13170	9314	10075	24582
7	14474	13650	10106	26884	37583	30929	10542	6109	3318	5850
8	8691	8545	7728	5211	14737	18307	13856	5615	2088	1942
9	860	5672	4738	3788	2732	8156	7149	6935	1824	987
10+	443	1930	4418	6200	3012	5731	4998	7342	6493	3736

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	164896	197380	325324	473467	394084	157162	183991	91407	162433	198635
2	219100	133830	156787	264593	387395	322595	128479	150542	74115	132979
3	53496	158275	92834	102455	186863	285898	258045	99606	97065	56207
4	42884	30999	109333	51050	62636	84622	121451	168372	55336	54550
5	20421	24801	19615	54115	25463	24301	19969	22375	56385	24277
6	15738	9163	14728	8869	21475	9893	8075	5324	7043	16747
7	12895	7366	4541	7153	2813	6390	4426	2748	2593	3121
8	2584	5847	3316	2120	1887	1070	2932	2184	1231	1094
9	1067	1248	1911	1614	526	532	457	1452	1050	595
10+	3790	4575	1779	1404	906	501	822	1037	825	645

Age	1990	1991	1992	1993	1994	1995
1	146453	261596	136022	160496	69096	0
2	158834	119642	213848	111100	131274	56484
3	100576	127087	86768	170124	84770	101781
4	32827	55005	64097	56212	108338	55446
5	21209	14594	20410	24974	29503	55730
6	9373	9139	6090	5993	10245	13478
7	4768	4318	4795	2429	2185	4940
8	1403	2023	2355	2651	612	1058
9	408	708	1001	1356	806	259
10+	509	506	667	1604	1395	870

Table 3.5.10 Saithe North Sea. RCT3 input: Age 1.

'YEARCLA	'VPA'	'EGFS2'	'EGFS3'	'SGFS2'	'SGFS3'	'NORW0'
1974	188	-1	484.92	-1	-1	-1
1975	141	104.54	57.36	-1	-1	-1
1976	127	72.39	104.99	-1	-1	-1
1977	104	2.79	179.6	-1	-1	-1
1978	269	18.6	119.76	-1	-1	-1
1979	165	94.55	2121.11	-1	1370	-1
1980	197	696.57	547.22	680	370	-1
1981	325	4.18	4643.56	500	26470	54
1982	473	2715.16	2710.97	8390	40140	76
1983	394	210.52	1708.74	50070	43180	50
1984	157	318.57	225.12	3160	1700	51
1985	184	24.94	786.6	170	1430	57
1986	91	84.74	178.41	350	1320	23
1987	162	68.73	872.71	290	4010	51
1988	198	580.69	426.47	3130	3180	43
1989	147	202.96	94.23	700	1840	39
1990	262	16.14	1091.48	310	7890	60
1991	-1	183.42	123.26	2010	1390	73
1992	-1	34.71	1366.47	810	13920	66
1993	-1	51.08	-1	270	-1	54
1994	-1	-1	-1	-1	-1	60
1995	-1	-1	-1	-1	-1	64

Table 3.5.11 Recruitment analysis of saithe in IV, age 1.
Analysis by RCT3 ver3.1 of data from file :

saiiv1.rct

North Sea Saithe : RCT3 input : Age 1 : Preliminary, September 1995

Data for 5 surveys over 22 years : 1974 - 1995

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1993

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
EGFS2	1.80	-3.15	3.26	.022	16	3.95	3.98	3.853	.007
EGFS3									
SGFS2	.49	1.93	.74	.319	11	5.60	4.65	.914	.120
SGFS3									
NORW0	1.96	-2.30	.41	.624	10	4.01	5.57	.496	.407
					VPA Mean =		5.30	.463	.466

Yearclass = 1994

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	1.93	-2.18	.40	.626	10	4.11	5.76	.509	.451
					VPA Mean =		5.29	.462	.549

Yearclass = 1995

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	1.89	-2.04	.40	.630	10	4.17	5.87	.526	.433
					VPA Mean =		5.28	.459	.567

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1993	204	5.32	.32	.17	.30		
1994	245	5.50	.34	.23	.46		
1995	253	5.54	.35	.29	.69		

Table 3.5.12 Recruitment analysis of saithe in IV, age 2.
Analysis by RCT3 ver3.1 of data from file :

saiiv2.rct

North Sea Saithe : RCT3 input : Age 2 : Preliminary, September 1995

Data for 5 surveys over 22 years : 1974 - 1995

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1993

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
EGFS2	1.89	-3.74	3.41	.020	16	3.95	3.71	4.032	.006
EGFS3									
SGFS2	.49	1.70	.75	.315	11	5.60	4.44	.923	.117
SGFS3									
NORW0	1.96	-2.49	.40	.629	10	4.01	5.36	.492	.413
					VPA Mean =		5.09	.464	.463

Yearclass = 1994

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	1.93	-2.37	.40	.631	10	4.11	5.56	.505	.456
					VPA Mean =		5.09	.463	.544

Yearclass = 1995

	I----------Regression----------I				I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
EGFS2									
EGFS3									
SGFS2									
SGFS3									
NORW0	1.89	-2.22	.39	.635	10	4.17	5.66	.521	.438
					VPA Mean =		5.08	.460	.562

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1993	167	5.12	.32	.17	.30		
1994	200	5.30	.34	.23	.46		
1995	207	5.34	.34	.29	.70		

TABLE 3.5.13 Saithe, North Sea
Mean fishing mortality, biomass and recruitment, 1970 - 1994.

Year	Mean F Ages 3 to 6	Stock Biomass ('000 tonnes) Total	Spawning	Recruits Age 1 Yclass	Million
1970	.449	1222	276	1969	237
1971	.340	1296	432	1970	231
1972	.409	1020	450	1971	242
1973	.434	890	485	1972	267
1974	.589	959	457	1973	542
1975	.510	842	370	1974	188
1976	.730	743	278	1975	141
1977	.642	564	227	1976	127
1978	.486	461	195	1977	104
1979	.406	496	191	1978	269
1980	.463	449	184	1979	165
1981	.313	545	193	1980	197
1982	.504	586	161	1981	325
1983	.615	685	169	1982	473
1984	.774	647	136	1983	394
1985	.852	590	107	1984	157
1986	.930	537	97	1985	184
1987	.689	393	100	1986	91
1988	.657	359	108	1987	162
1989	.723	371	89	1988	199
1990	.558	334	78	1989	146
1991	.599	417	78	1990	262
1992	.680	450	84	1991	136
1993	.549	447	95	1992	160
1994	.451	398	99	1993	204*
Arithmetic mean recruits, age 1, 1970 to 1992:					228
Geometric mean recruits, age 1, 1970 to 1992:					206

* RCT3 estimate

TABLE 3.5.14 Saithe, North Sea
Input for Catch Prediction

Age	1995 Stock Numbers (10**-3)	F and mean Wt at age used in prediction: Scaled Mean F 1990 - 1994	Mean Wt. at age (kg) 1990 - 1994: Stock	Catch	M and maturity: M	P. mat
1	245000	.001	.375	.375	.200	.000
2	167000	.047	.599	.599	.200	.000
3	101781	.254	.863	.863	.200	.000
4	55446	.485	1.191	1.191	.200	.150
5	55730	.574	1.674	1.674	.200	.700
6	13478	.489	2.412	2.412	.200	.900
7	4940	.502	3.404	3.404	.200	1.000
8	1058	.475	4.461	4.461	.200	1.000
9	259	.567	5.849	5.849	.200	1.000
10	870	.567	7.389	7.389	.200	1.000

	Mean F
Unscaled	(3 - 6) .567
Scaled	.451

Recruits at age 1 in 1996 = 253000
Recruits at age 1 in 1997 = 205604

Stock numbers in 1995 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 3.5.15 Saithe North Sea
Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year							
	1995	1996						
Mean F Ages								
H.cons 3 to 6	.45	.00	.18	.27	.32	.36	.45	.54
Effort relative to 1994								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Biomass at start of year								
Total	501	554	554	554	554	554	554	554
Spawning	134	141	141	141	141	141	141	141
Catch weight (,000t)								
H.cons	105	0	50	72	82	92	111	128
Biomass at start of 1997								
Total		728	665	638	625	613	590	569
Spawning		245	201	183	174	166	150	136

	Year							
	1995	1996						
Effort relative to 1994								
H.cons	1.00	.00	.40	.60	.70	.80	1.00	1.20
Est. Coeff. of Variation								
Biomass at start of year								
Total	.15	.16	.16	.16	.16	.16	.16	.16
Spawning	.16	.18	.18	.18	.18	.18	.18	.18
Catch weight								
H.cons	.20	.00	.38	.28	.25	.23	.20	.19
Biomass at start of 1997								
Total		.14	.15	.16	.16	.16	.16	.17
Spawning		.17	.19	.19	.19	.20	.20	.20

Forecast for year 1995
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	245000	222	222
2	167000	6955	6955
3	101781	20780	20780
4	55446	19468	19468
5	55730	22270	22270
6	13478	4763	4763
7	4939	1782	1782
8	1058	365	365
9	258	102	102
10	870	344	344
Wt	501	105	105

Forecast for year 1996
F multiplier H.cons=1.00

Populations		Catch number	
Age	Stock No.	H.Cons	Total
1	253000	229	229
2	200389	8345	8345
3	130450	26633	26633
4	64639	22696	22696
5	27950	11169	11169
6	25701	9082	9082
7	6767	2441	2441
8	2448	845	845
9	539	213	213
10	524	207	207
Wt	554	111	111

Table 3.5.16 Saithe North Sea
Input data for catch forecast and linear sensitivity analysis.

Populations in 1995			Stock weights			Nat.Mortality			Prop.mature		
Labl	Value	CV	Labl	Value	CV	Labl	Value	CV	Labl	Value	CV
N1	245000	.34	WS1	.38	.43	M1	.20	.10	MT1	.00	.00
N2	167000	.32	WS2	.60	.11	M2	.20	.10	MT2	.00	.00
N3	101781	.34	WS3	.86	.08	M3	.20	.10	MT3	.00	.10
N4	55446	.37	WS4	1.19	.06	M4	.20	.10	MT4	.15	.10
N5	55730	.26	WS5	1.67	.07	M5	.20	.10	MT5	.70	.10
N6	13478	.20	WS6	2.41	.08	M6	.20	.10	MT6	.90	.10
N7	4939	.21	WS7	3.40	.06	M7	.20	.10	MT7	1.00	.10
N8	1058	.24	WS8	4.46	.05	M8	.20	.10	MT8	1.00	.00
N9	258	.29	WS9	5.85	.10	M9	.20	.10	MT9	1.00	.00
N10	870	.28	WS10	7.39	.13	M10	.20	.10	MT10	1.00	.00

HC selectivity			HC.catch wt		
Labl	Value	CV	Labl	Value	CV
sH1	.00	.28	WH1	.38	.43
sH2	.05	.63	WH2	.60	.11
sH3	.25	.34	WH3	.86	.08
sH4	.49	.17	WH4	1.19	.06
sH5	.57	.12	WH5	1.67	.07
sH6	.49	.24	WH6	2.41	.08
sH7	.50	.54	WH7	3.40	.06
sH8	.48	.47	WH8	4.46	.05
sH9	.57	.35	WH9	5.85	.10
sH10	.57	.35	WH10	7.39	.13

Year effect M			HC relative eff		
Labl	Value	CV	Labl	Value	CV
K95	1.00	.10	HF95	1.00	.15
K96	1.00	.10	HF96	1.00	.15
K97	1.00	.10	HF97	1.00	.15

Recruitment		
Labl	Value	CV
R96	253000	.35
R97	205604	.45

Stock numbers in 1995 are VPA survivors.
These are overwritten at Age 1 Age 2

Table 3.5.17 Saithe North Sea. Model parameters for stock-recruitment

Saithe North Sea.,,,

Data read from file recruinn.csv

Beverton-Holt curve
Moving average term NOT fitted

IFAIL on exit from E04FDF =, 0

Residual sum of squares=, 4.0889

Number of observations=, 23

Number of parameters =, 2

Residual mean square =, .1947

Coefficient of determination =, .1021

Adj. coeff. of determination =, .0594

IFAIL from E04YCF=, 0

Parameter Correlation matrix

, 1.0000,
, -.9905, 1.0000,

Parameter,s.d.

4.9486, 3.3126,
55.0458, 48.7265,

Table 3.5.18

Stock: Saithe in Sub-area IV and Division IIIa (North Sea)

Assessment Quality Control Diagram 1

Average F(3-6,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	0.46	0.40						
1990	0.62	0.51	0.39					
1991	0.69	0.65	0.72	0.64				
1992	0.68	0.67	0.75	0.65	0.73			
1993	0.68	0.67	0.73	0.59	0.59	0.59		
1994	0.67	0.65	0.69	0.51	0.55	0.60	0.48	
1995	0.69	0.66	0.72	0.56	0.60	0.68	0.55	0.45

Remarks:

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: millions								
Date of assessment	Year class							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	166	237						
1990	235[1]	230[1]	232[1]					
1991	187	212[1]	211[1]	211[1]				
1992	168	308	214[1]	214[1]	214[1]			
1993	179	201	108	191[1]	191[1]	191[1]		
1994	167	203	128	198	214	204	206[1]	
1995	162	199	146	262	136	160	204[2]	245[2]

[1]Geometric average recruitment.
[2]RCT3 estimates.
Remarks:

Table 3.5.18 Continued

Stock: Saithe in Sub-area IV and Division IIIa (North Sea)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	186	236	244[1]	240[1]						
1990	125	122	166	206[1]	233[1]					
1991	106	87	74	70	79[1]	85[1]				
1992	102	82	66	56	68	83[1]	79[1]			
1993	102	84	69	70	81	81	76[1]	85[1]		
1994	109	90	81	82	91	105	99	115[1]	125[1]	
1995	108	89	78	78	84	95	99	134	141[1]	150[1]

[1]Forecast.

Remarks:

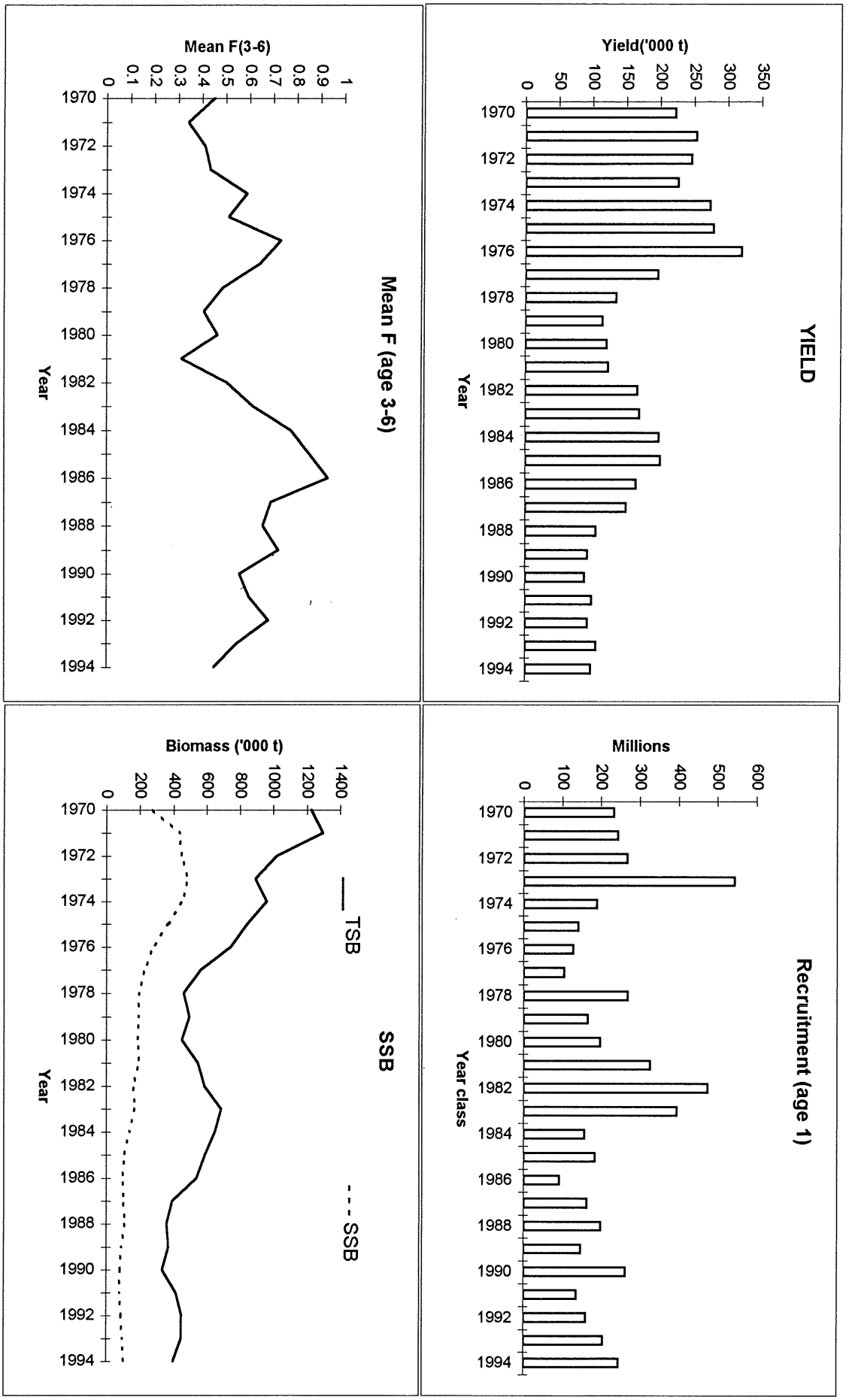
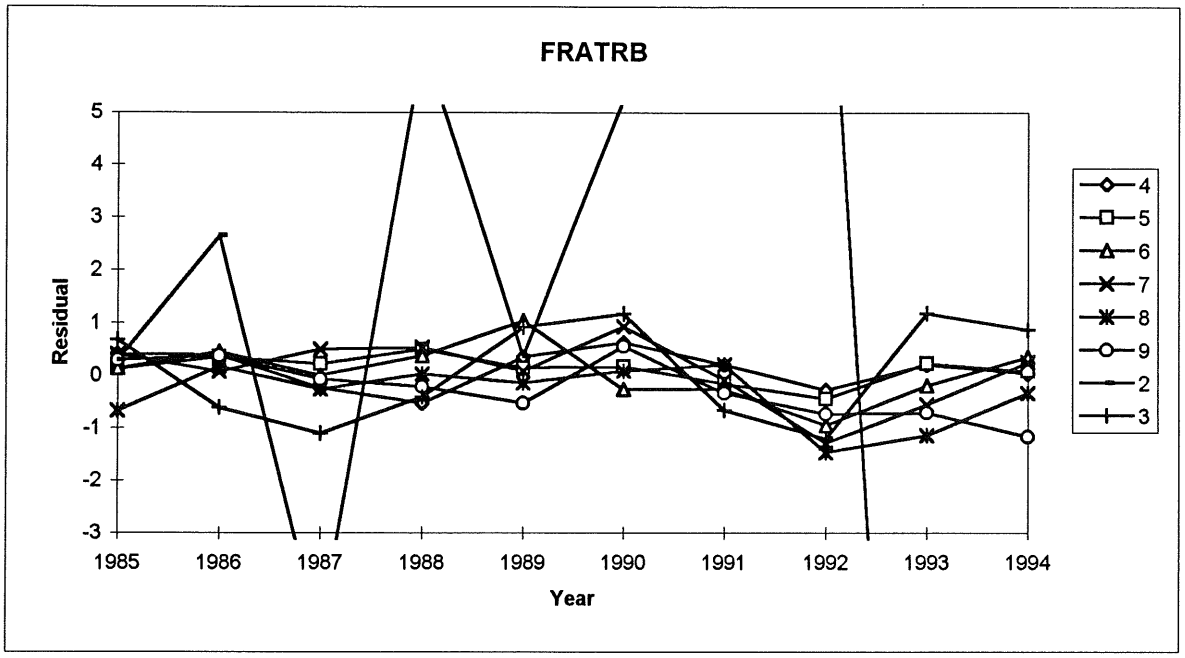


Figure 3.5.1 Saithe North Sea and Division IIIa

Figure 3.5.2 Saithe North Sea. Residuals from XSA analysis for French and Norwegian trawlers



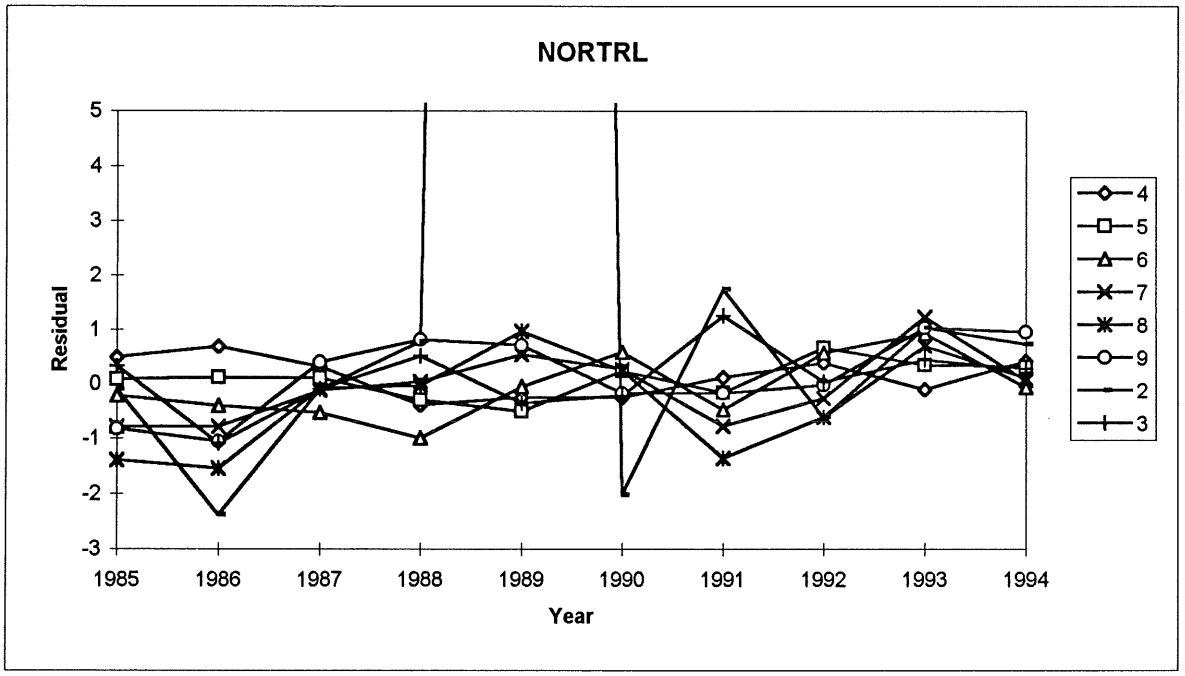


Figure 3.5.3 Saithe North Sea. Retrospective analysis

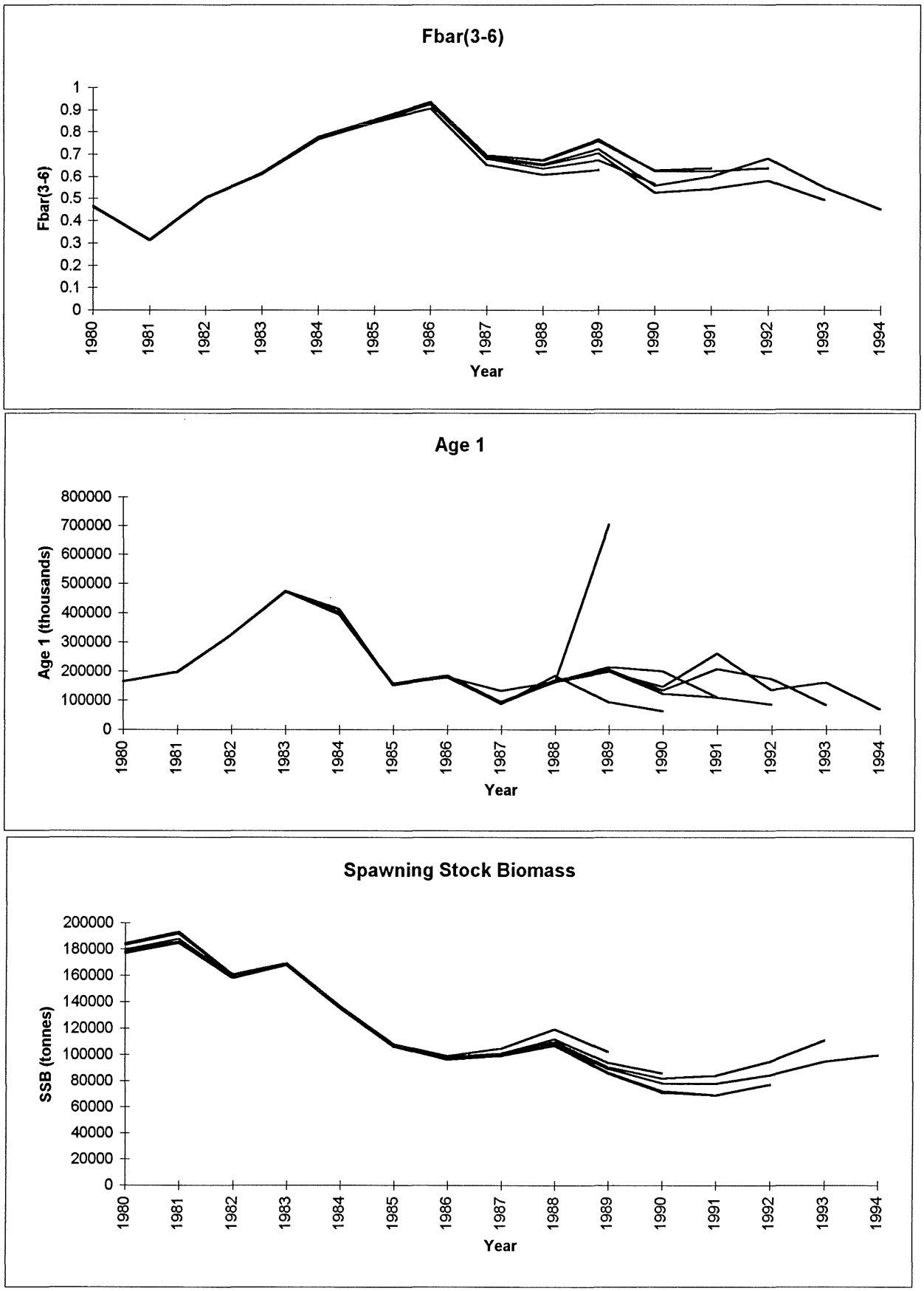


Figure 3.5.4 Saithe North Sea. RV indices and VPA estimates.

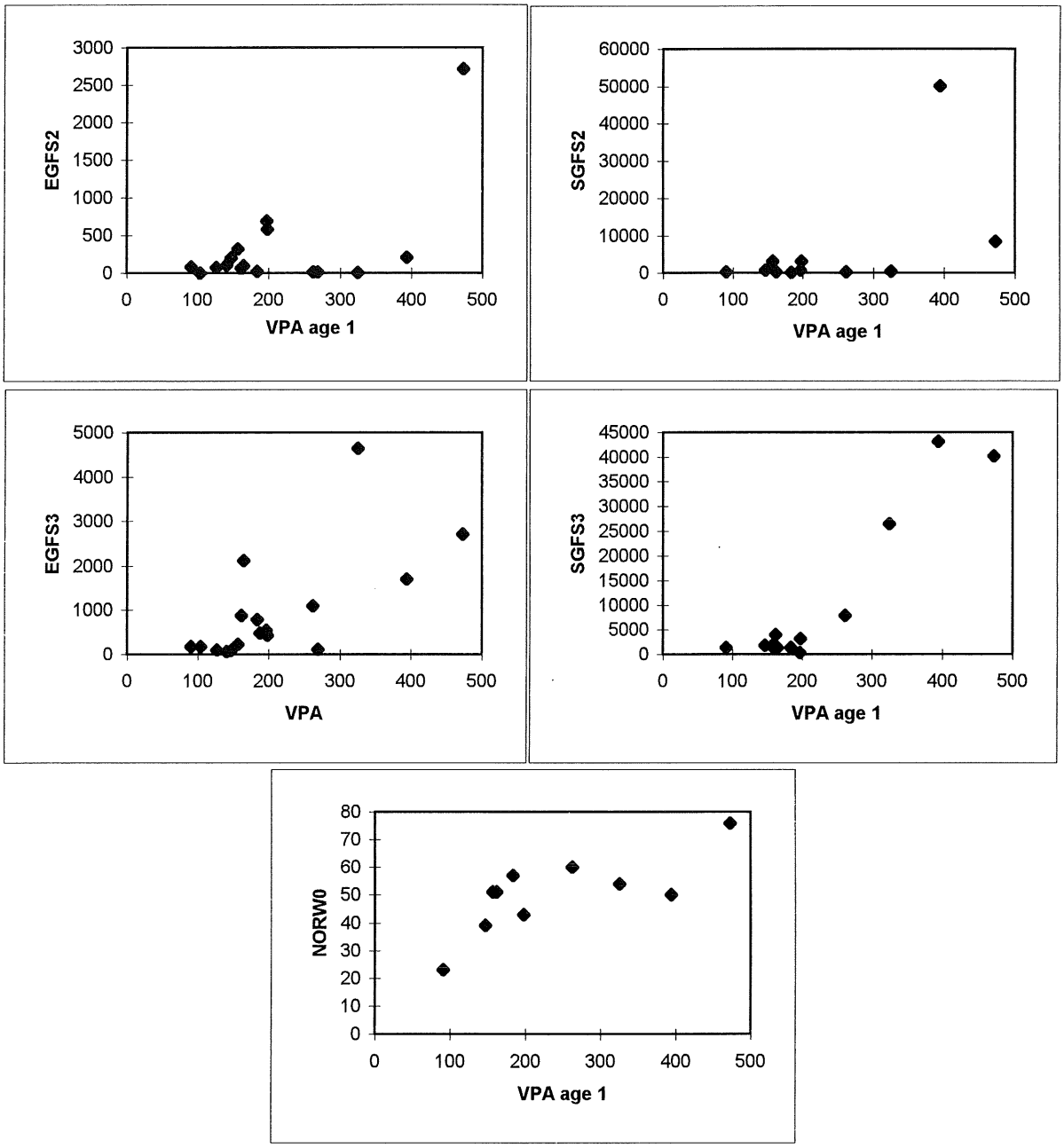


Figure 3.5.5 Saithe North Sea. Recruitment on spawning stock biomass

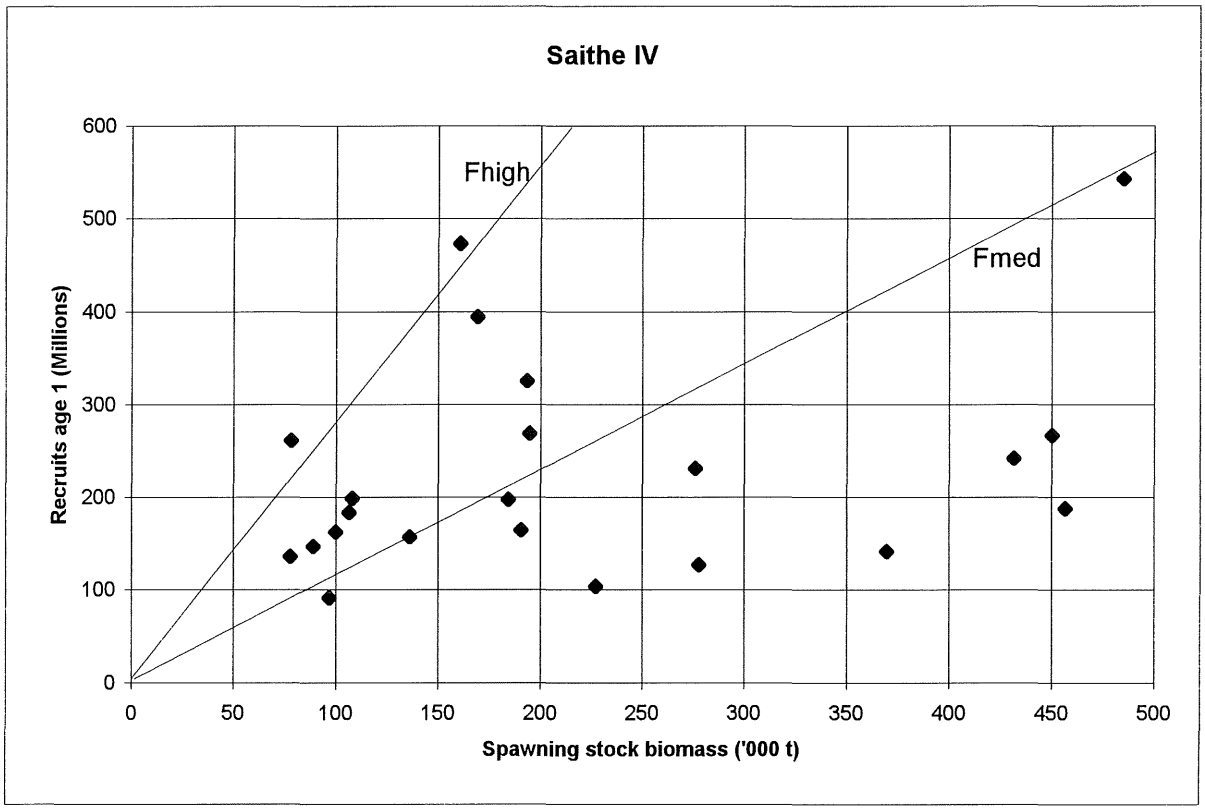


Figure 3.5.6 Saithe North Sea. Yield per recruit

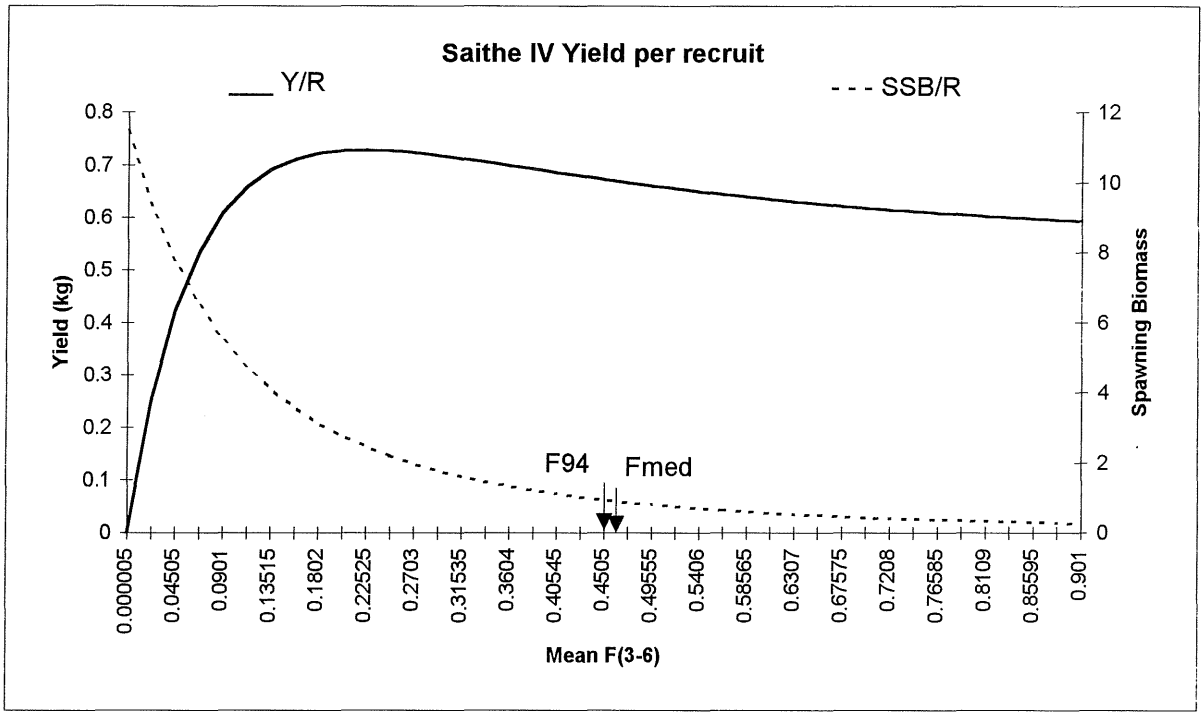


Figure 3.5.7 Saithe North Sea. Yield and SSB in the short term prediction

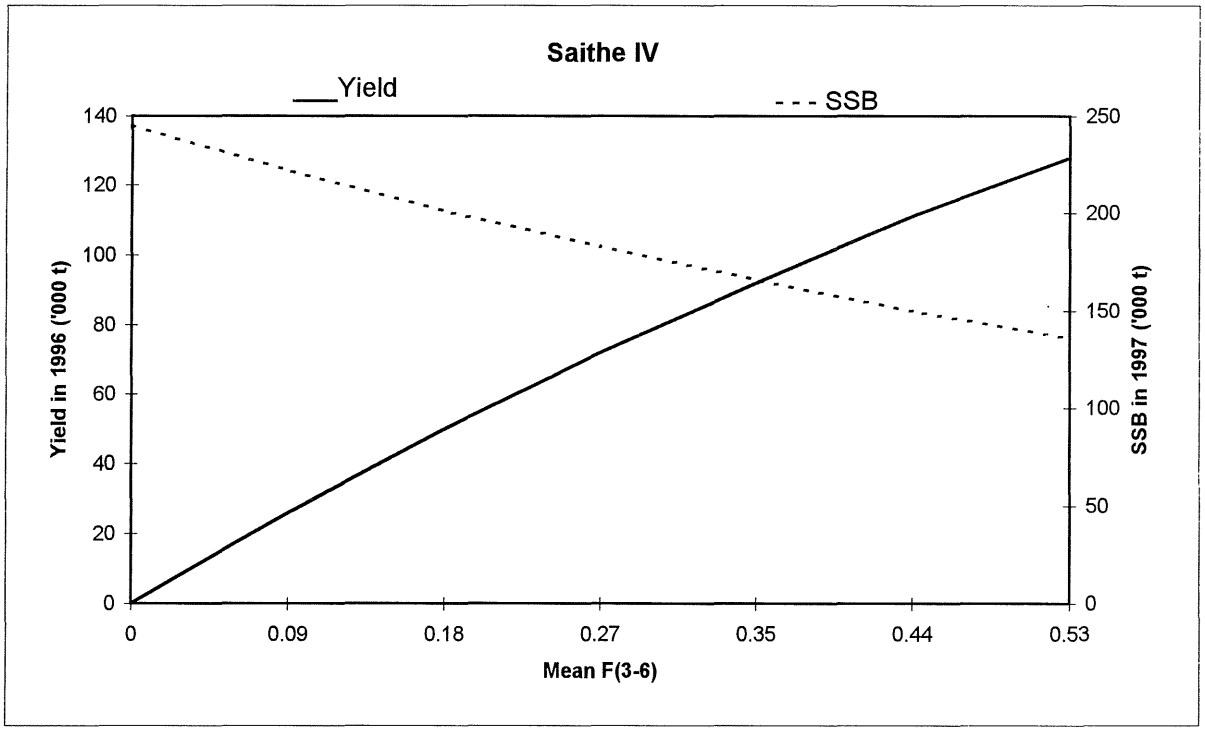


Figure 3.5.8 Saithe North Sea. Sensitivity analysis of short term forecast Linear sensitivity coefficients (elasticities).

Figure 3.5.9 Saithe North Sea. Sensitivity analysis of short term forecast.
Proportion of total variance contributed by each input value

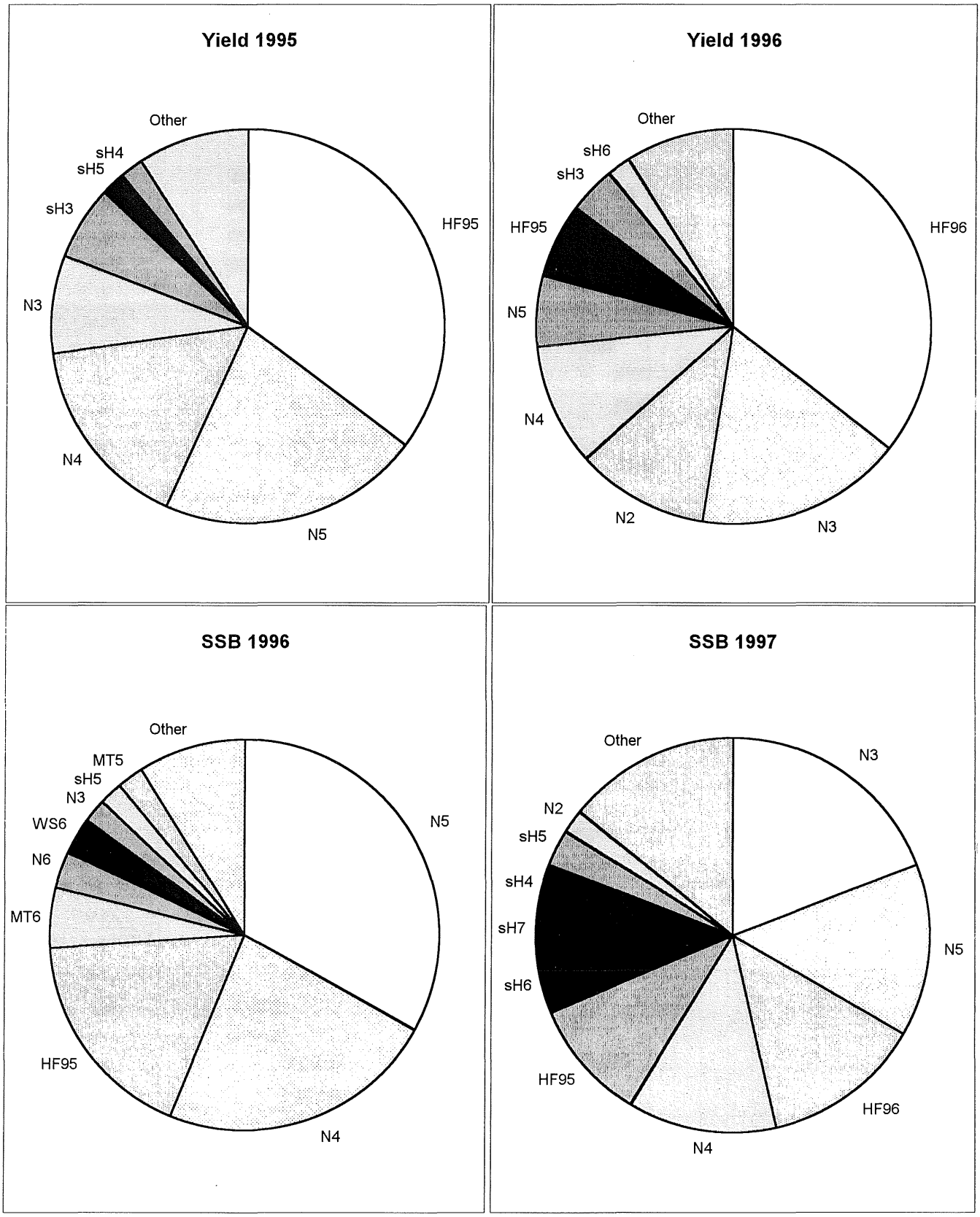
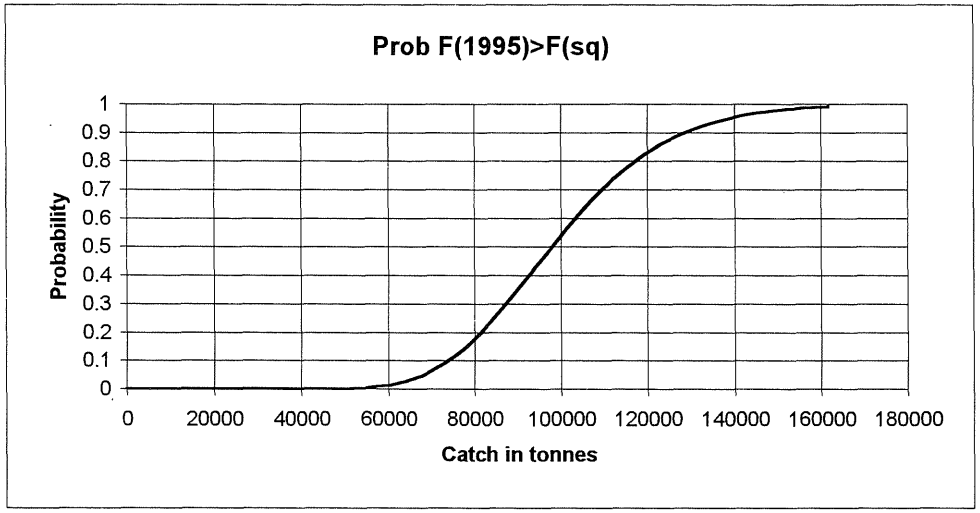
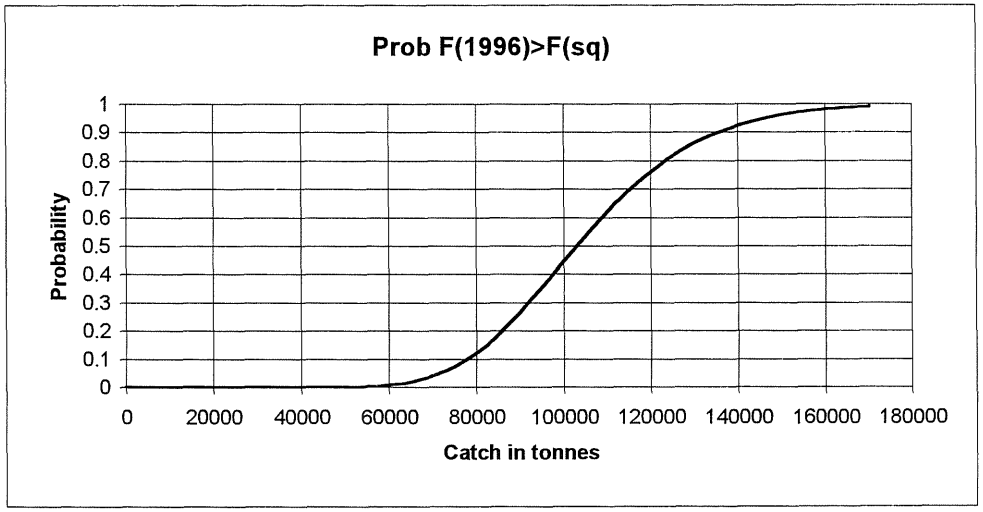
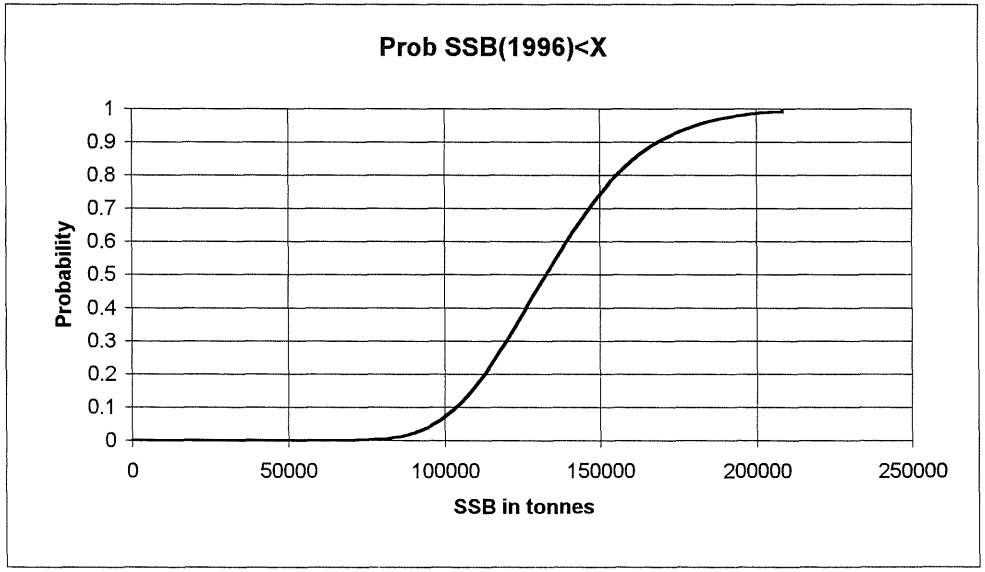


Figure 3.5.10 Saithe North Sea. Sensitivity analysis of short term forecast.
Cumulative probability distributions.







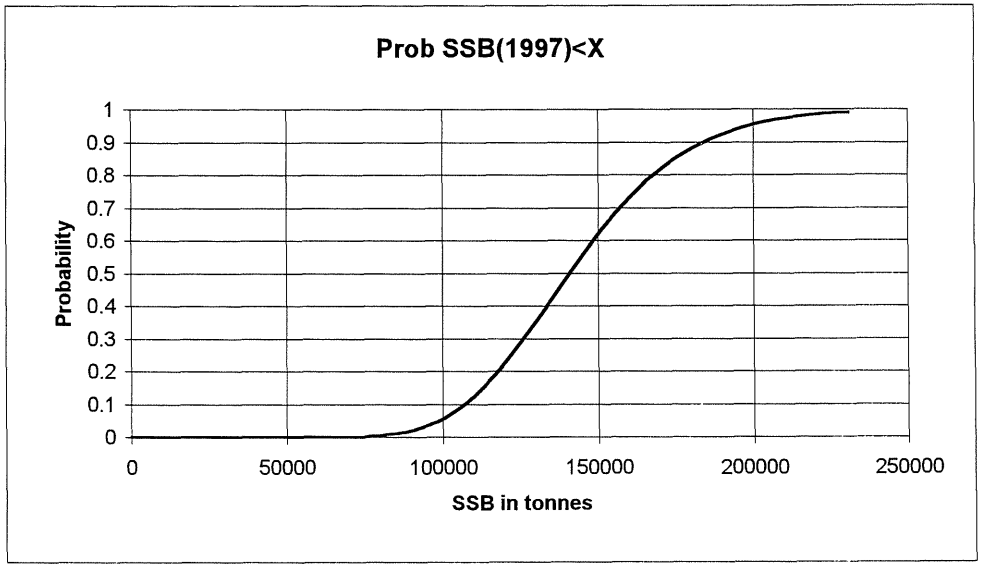
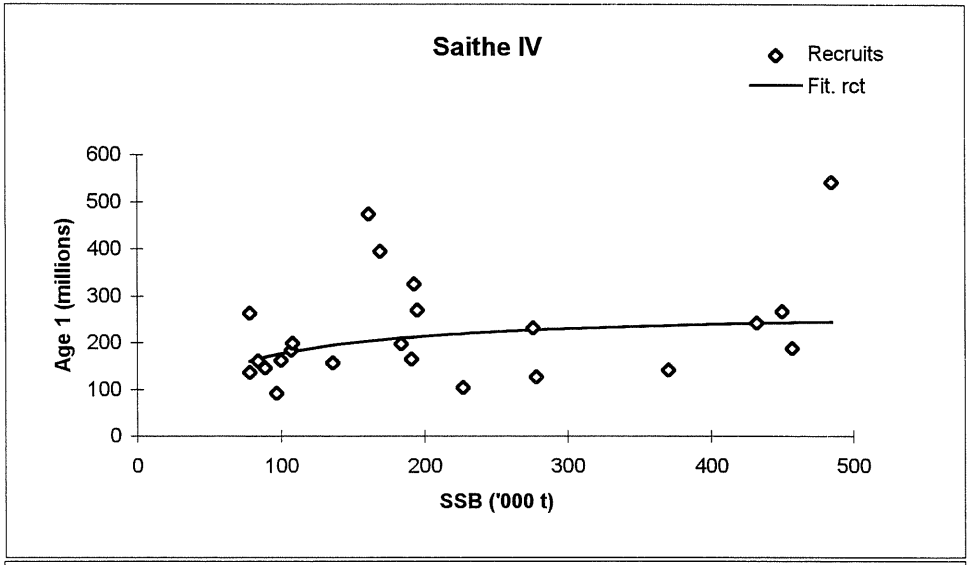
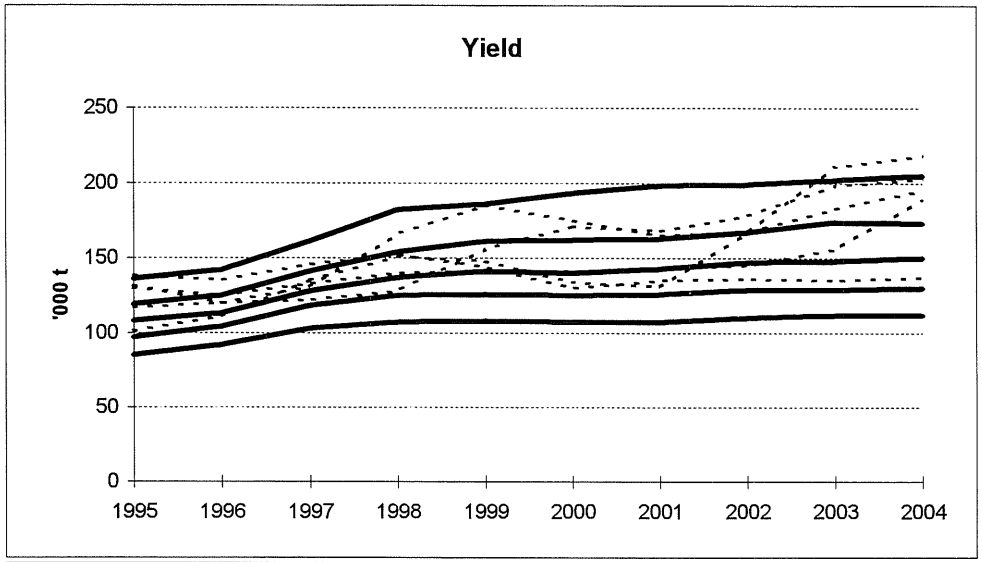
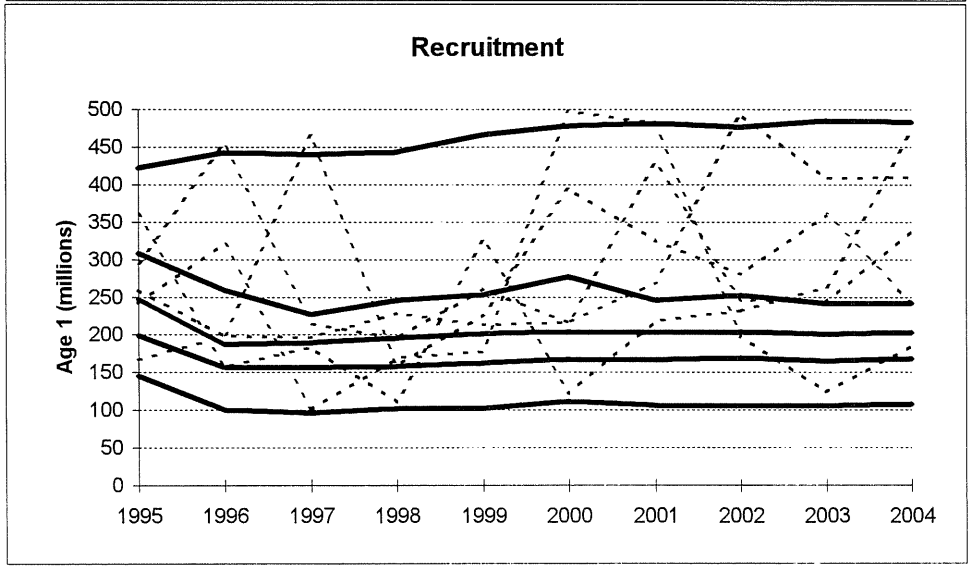


Figure 3.5.11 Saithe North Sea. Medium term predictions. Status quo Fishing mortality. Solid lines show 5, 25, 50, 75 and 95 percentiles. Dashed lines show five sample trajectories. Number of simulations=500.







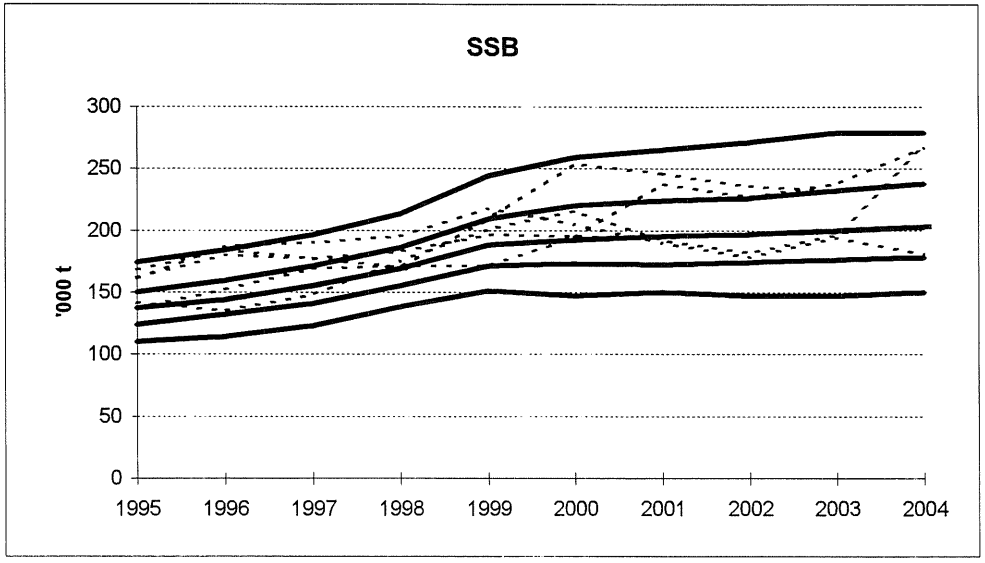


Figure 3.5.12 Saithe North Sea. Medium term predictions.Adjusted Status quo Fishing mortality. Solid lines show 5, 25, 50, 75 and 95 percentiles. Dashed lines show five sample trajectories. Number of simulations=500.

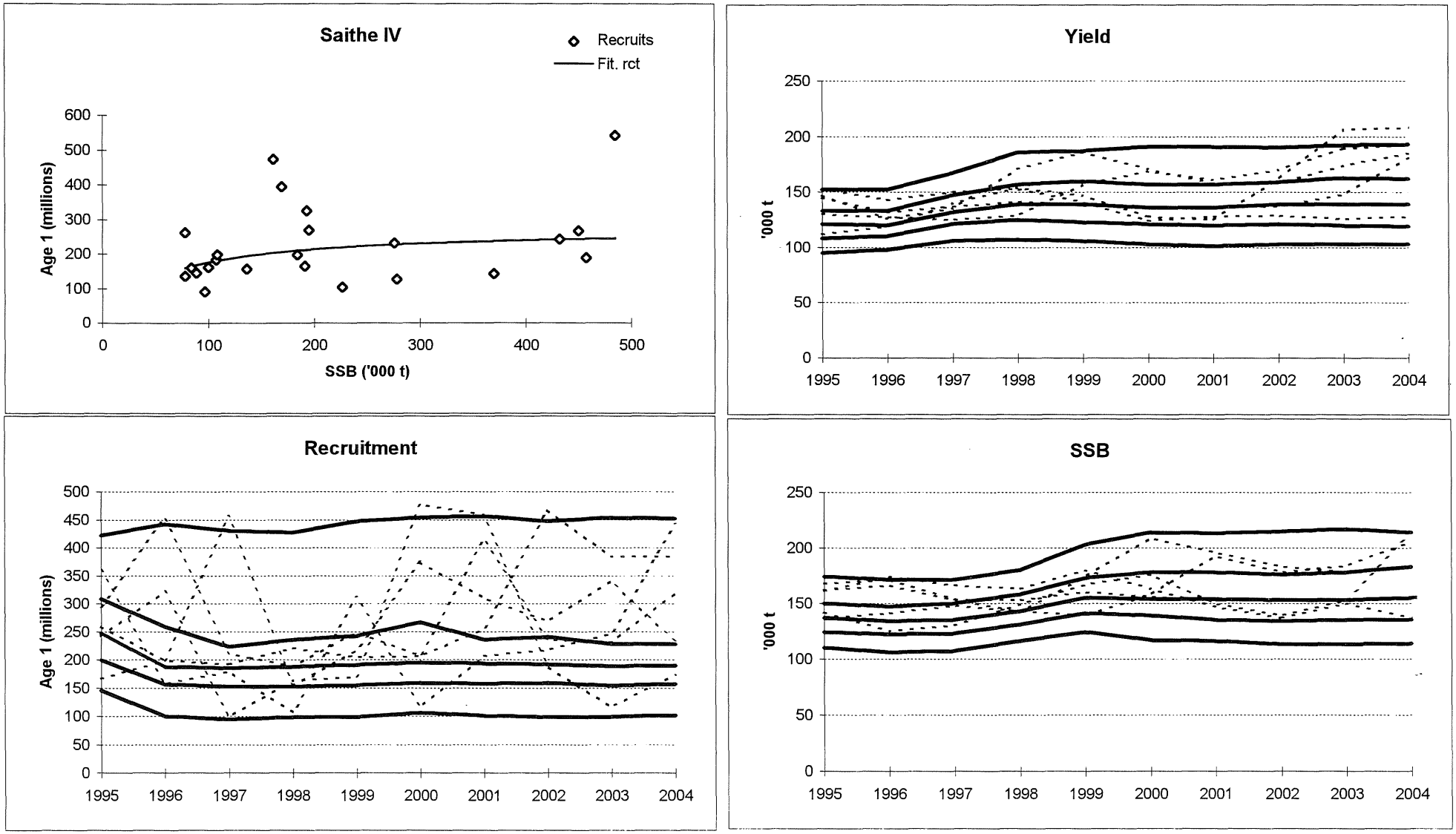
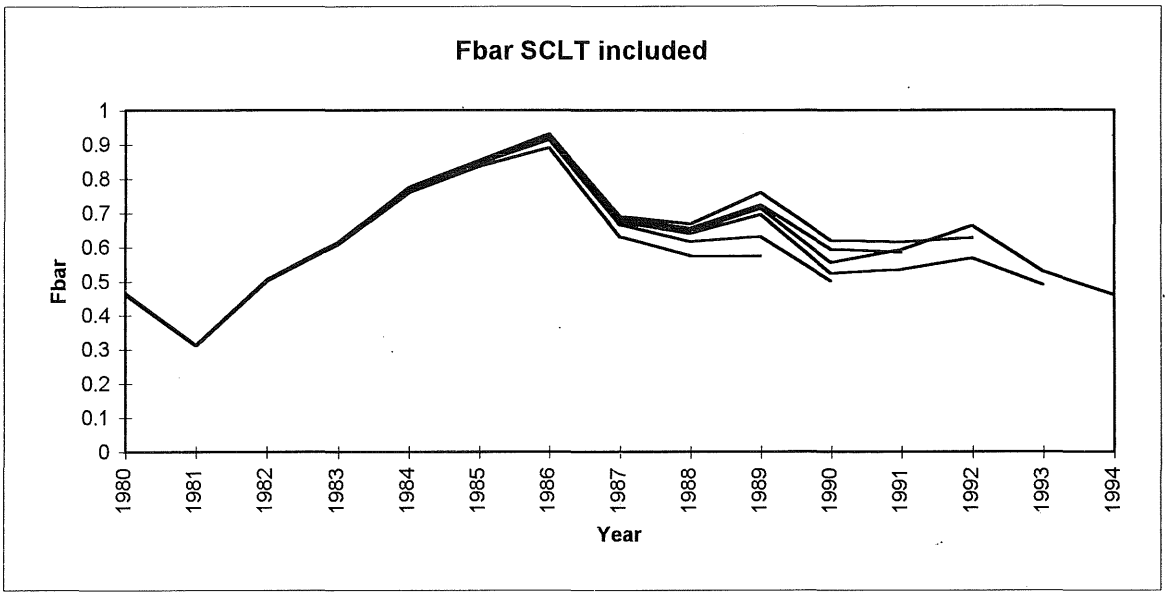
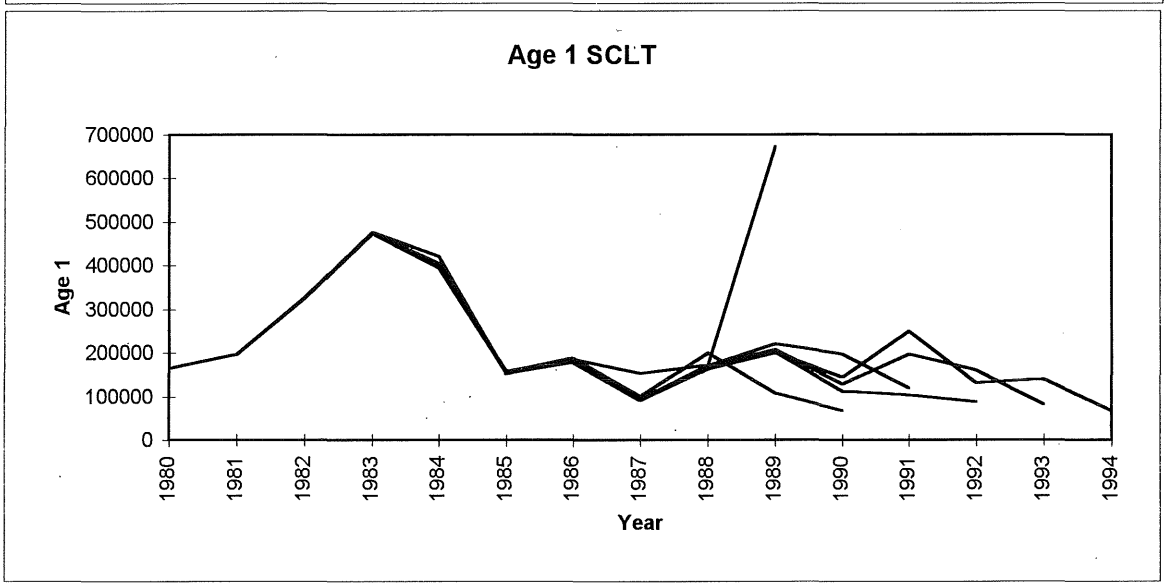
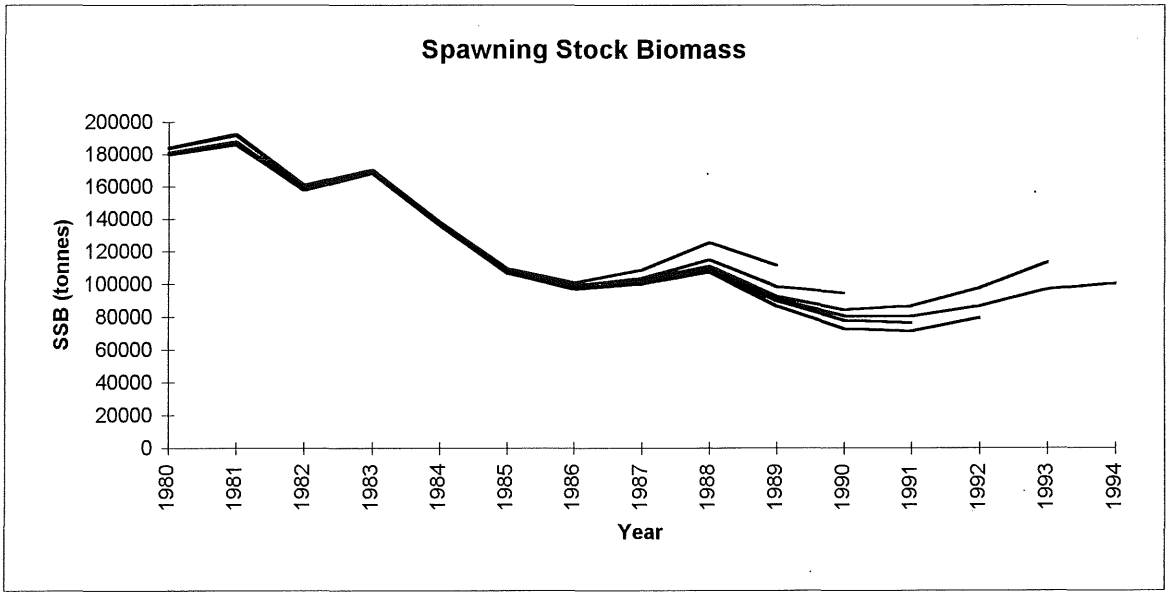


Figure 3.5.13 Saithe North Sea. Retrospective analysis including Scottish Light Trawl







3.6 Sole in Sub-area IV

3.6.1 Catch trends and historical developments

The total nominal landings reported to ICES are given in Table 3.6.1. The 1993 total landings as used by the Working Group (31,170 t) was modified to 31,428 t mainly due to an increase in reported landings by UK (England & Wales). Total international landings as used by the Working Group for 1994 were 32,669 t, 2 % higher than the TAC of 32,000 t. The estimates of the unallocated landings have decreased considerably in recent years. These are mainly due to small discrepancies between officially reported figures and those available to the Working Group members. For most of the time series, the unallocated landings were based on market sampling. Now they are based more on soft estimates. Historical trends in landings are given in Figure 3.6.1.a. In the last four years the landings are on a high level and dominated by year classes 1987 and 1991. Sole is mainly taken by beam trawl fleets in a mixed fishery with plaice in the southern part of the North Sea. There is also a directed gill-net fishery in Danish coastal areas, predominantly in the 2nd quarter of the year. Since 1989, the distribution pattern of beam trawl fleets > 300 HP has changed due to the introduction of the "Plaice-Box" in the south-eastern part of the North Sea. The minimum mesh size in this fishery is 80 mm.

3.6.2 Natural mortality, maturity, age compositions, mean weight at age

Quarterly data for 1994 were available for catch numbers and weight at age, by sex from Belgium, Denmark, the Netherlands and UK (England & Wales). These comprise more than 87% of the international landings. The data were combined and then raised to the international total. The SOP of the combined 1994 age composition was 1% higher than the total landings. Only minor revisions were made to the 1993 data as a consequence of revisions in the national landings and in the unreported landings. No estimates of discards are available to the Working Group.

Weights at age in the stock are measured as second quarter weights of the catch. The age compositions and weights at age in the catch and in the stock are given in Tables 3.6.2, 3.6.3 and 3.6.4.

ACFM asked the Working Group to investigate the maturity-ogive for this stock, assuming that a gradual increase in maturity would be more realistic. There is evidence that maturity has changed over time in relation to changes in growth of sole but the data has not been fully investigated, and there is a lack of data for earlier years. Since changes in the maturity ogive will affect the historical pattern of SSB and could influence the definition of MBAL, it was decided not to change the current ogive until further analysis can be undertaken.

As in previous assessments therefore, a knife-edged maturity-ogive was used in all years, assuming full maturation at age 3. Natural mortality has been assumed constant over ages and years at a level of 0.1, except for 1963, when a value of 0.9 was used to take account of the effects of a severe winter (Anon. 1979).

3.6.3 Catch, effort and research vessel data

Catch and effort data were available for four fleets. The tuning data are presented in Table 3.6.5. The "Netherlands all Fleets" is a beam trawl fleet, for which effort is on a record high level. The other 3 fleets are surveys. The SNS (Sole Net Survey) is a coastal survey carried out by the Netherlands with a 6-m beam trawl in October. The German SOLEA survey is carried out in May in the south-eastern North Sea with a 7-m beam trawl. The BTS (Beam Trawl Survey) is carried out by the Netherlands in the southern and south-eastern North Sea in August and September using an 8-m beam trawl.

3.6.4 Catch at age analysis

Data screening

General approaches and methods are described in section 1.3. As in previous assessments, the age range for the analyses was 1-15+, and tuning was performed using data over a 10 year period.

A preliminary inspection of the quality of the international catch-at-age data was carried out using separable VPA with a reference age of 4, terminal F= 0.5 and terminal S= 0.8. Although as in last years assessment, some large residuals were observed at age 1 and in the older ages (11 and older), the log-catch ratios for the fully recruited ages (3 up to 10) did not show any patterns or large residuals (available in ICES stock files).

The tuning data were examined for trends in catchability by carrying out Laurec-Sheperd (L/S) tuning runs without shrinkage, using data for each of the four fleets individually. Although in the surveys, catchability was variable in the less well sampled ages, examination of the residuals and regression slopes revealed no apparent trends. The Dutch fleet, however, shows a decline in catchability up to 1989, indicating the need of a strong taper in the final XSA (available in ICES files).

Exploratory XSA-runs

Trial runs were made with q dependent on year class strength for ages less than 2, 3 and 4 respectively. The standard errors on q were slightly better for the runs with q dependent on year class strength for ages less than 3, hence there was no need to change last year's settings for this parameter. A comparison of catchability values at age for each fleet suggested that the "q-plateau" at age 7 used last year, was still appropriate.

To test for the effect of shrinkage on the analysis, F shrinkage SEs of 0.3, 0.5, 0.8 and 1.0 were used in further XSA runs. The trends in mean F for these runs (in ICES stock files) show very little influence of shrinkage and last year's value of 0.5 was therefor not changed.

As the Dutch fleet showed a downward trend in catchability in early years, a tricubic taper over 10 years was applied. Investigation of the effect of the taper using retrospective analysis (Figure 3.6.2) shows that there was, in fact, little difference between runs using either a strong 10 year taper and no taper.

Final XSA-run

The settings for the final XSA-run were the same as last year, i.e.: catchability dependent on stock size for ages < 3, catchability independent of age for ages >= 7, a shrinkage of 0.5 and a tricubic taper over 10 years.

The log catchability residuals from the final XSA-run are shown in Figure 3.6.3. It should be noted that the downward trend in catchability clearly observed for the Dutch fleet in the trial L/S run is masked in the final XSA-run due to the interaction of the other fleets.

The XSA tuning diagnostics are given in Table 3.6.6

The diagnostics of the tuning indicate that for age 1 almost 60% of the weight is given by the Beam Trawl survey (BTS). The F shrinkage and the Tridens survey being the only two contributors with 21% and 10% respectively. For age group 2, the weight is more equally divided between the fleets and the F shrinkage. Population shrinkage was of no influence for these two ages. Except for the 1, 2 and 3 year olds, most weight has been given to the Dutch beam trawl fleet and to a lesser extend to the BTS survey in the estimation of the survivors. The SNS and SOLEA surveys give most weight to the age 3 estimates. In age groups older than 10, the influence of the shrinker on the combined estimated is increasing. It should be noted that fishing mortality at age 4 is exceptionally high. Hence it is not clear from the catch at age data what has caused this inconsistency.

The final VPA output is given in Table 3.6.7 (fishing mortality) and Table 3.6.8 (stock numbers).

3.6.5 Recruitment estimates

Average recruitment in the period 1957-1992 was 139 million (arithmetic mean) or 101 million (geometric mean) 1-year-old fish.

No independent indices of recruitment were available from pre-recruit surveys carried out in 1995 since the surveys are not completed yet. Like last year, it is expected that these indices will become available after the meeting of the present Working Group and will be made available to ACFM in November 1995.

Preliminary estimates of recent year classes were made using the log regressions between the indices available from surveys carried out in previous years with the 1 and 2-year-olds from the VPA using RCT3. These series are the same as those used last year plus the 1 and 2 year old indices of the Dutch BTS. The indices are given in Table 3.6.9, and the relationship between survey indices and PA are shown in Figure 3.6.4. The options used in RCT3 were the same as those used last year and are listed in Table 3.6.10. The results are given in the same table.

1992 year class: This year class is poor as 0- and 1-group in the continental surveys. In the UK nurseries it was, however, average as 0-group and good as 1-group. The year class was at a low level in the age composition of the 1994 landings. The BTS estimates it to be average at age 1 but poor at age 2. Since all the survey indices were included in XSA, the estimate of the VPA has been used in the prediction

1993 year class: This year class was weak as 0- group in the continental surveys. In the UK nurseries it was about average strength as 0- and 1-group. The Tridens 1- group as well as the BTS 1- group estimates it as poor. Only the BTS 2- group estimates it as average. The RCT3 estimate is 53 million as 1-year olds and 48 million as 2-year olds, compared with 114 million in XSA. The XSA estimate is based on the Netherlands BTS survey (60%) and F shrinkage (21%). Despite the lower weighting of the F shrinkage, it influences the weighted mean upwards because it predicts a very high survivors value of 302 million. The high variance ratio of this estimate (1.5) indicates that it is not particularly reliable. In view of the fact that additional survey estimates are to be provided to ACFM and the final figure will consequently be based on a recruit prediction, the RCT3 estimate of 48 million 2-year olds has been used in the forecast.

1994 year class: Although this year class indicated to be below average by the continental surveys, it was estimated by the NBTS 1- group above average. This survey has a good correlation with the VPA as it estimated well the two big year classes from 1987 and 1991 (Figure 3.6.4) . It therefor is given a large weight in the final RCT3 estimates. The RCT3 estimate of 183 million and has been used in the prediction, but is subject to revision by ACFM when additional survey indices for 1995 become available.

Hence preliminary indications from surveys suggested there will be a substantial downweighting of the 1994 year class.

The GM recruitment for age 1 (101 million) was used for the 1995 and 1996 year classes.

3.6.6 Historical stock trends

Trends in landings, recruitment, fishing mortality and SSB are shown in Figures 3.6.1.a-d and in the assessment summary table (Table 3.6.11).

Average Fishing mortality F(2-8)u increased since 1957 from 0.14 to a peak of 0.55 in 1984. Since then F has varied between 0.40 and 0.50.

The recruitment of North Sea Sole shows considerable variation from year to year. In recent years two outstanding year classes appeared (born in 1987 and 1991), dominating landings. Year classes 1988 and 1989 were above GM average but year classes born in 1990 and 1992 were well below average.

Trends in SSB are associated with the occurrence of strong year classes. It was at a historically high level near 150,000 t in the years' 1961-1963 but severely reduced thereafter due to high natural mortality in the cold 1963 winter. The 1963 year class build it up again to 105,000 t in 1966. Thereafter it decreased due to an increase of fishing mortality and the absence of very strong year class. In the period 1973-1989 it has fluctuated between 25.000 t and 45,000 t. In 1990, it increased sharply to 93,000 t when the 1987 year class recruited in the SSB and remained high in 1991 and 1992. In 1993 it decreased to 58,000 t but subsequently increased again in 1994 to 82,000 t when the 1991 year class recruited in the SSB.

3.6.7 Biological reference points

Figure 3.6.5 shows the SSB/recruitment scatter plot. At the observed levels of biomass there are no indications that recruitment has declined.

The SSB recruitment plot also shows the position of F_{med} and F_{94}. F_{94} is higher than F_{med}.

The input parameters for the yield and biomass-per-recruit calculations are given in Table 3.6.12. The results of the calculations are given in Table 3.6.13 and Figure 3.6.6.

The biological reference points are almost at the same position as last year and are as follows:

$F_{0.1}$	F_{low}	F_{max}	F_{med}	F_{94}	F_{high}
0.09	0.04	0.24	0.33	0.50	>1.00

3.6.8 Short term forecast

The input parameters for the catch forecast are given in Table 3.6.12. The stock numbers for ages 1 and 2 in 1995 were estimated from recruitment surveys and may have to be changed by ACFM when new information on the recruitment of recent year classes becomes available from the 1995 recruitment surveys.

The weights at age used were the averages of the last 3 years in the catch and in the stock. The exploitation pattern used was the average of the last 3 years in the VPA scaled to the 1994 level.

The Management Options are presented in Tables 3.6.14, 3.6.15 and Figure 3.6.6. A *status quo* level of fishing mortality has been assumed for 1995 in the prediction. The expected catch in 1995 is 32,000 t. The spawning stock biomass is predicted to decrease from 72,000 t in 1995 to 50,000 t in 1996, due to the poor 1993 year class. At a *status quo* level of fishing mortality in 1996, the expected catch is 25,000 t leaving a slightly higher SSB of 55,000 t in 1997, being above Mbal (35.000 t)

As last year, a sensitivity analysis has been carried out, using a linear method described by Cook (1993). The input values and accordingly CV's are presented in Table 3.6.16.

Figure 3.6.7 shows the sensitivity of the forecast of the predicted Yields in 1995 and 1996 and the predicted biomasses in 1996 and 1997 to the input parameters. Apart from the relative level of fishing mortality for 1995 and 1996 (HF95,96), the estimate of catch in 1996 is most sensitive to the population numbers of 4 year olds (N4), weight of 4 and 5 year olds (WH4,5) and fishing mortality of the 4 and 5 year olds(sH4,5). Spawning stock biomass in 1996 and 1997 are more sensitive to the natural mortality (MT3,5), weight in the stock of 3 and 5 year olds (WS3,5),and the population number of 1 and 4 year olds (N1,4).

Figure 3.6.8 shows the partial variances (proportions), estimated from the linear analysis for the forecast. The variance of the yield in 1995 and SSB in 1996 is mostly determined by the assumed level of fishing mortality (sH4) and the population estimates (N4) of the 1991 year class. It should be noted that the dominancy of this proportion of variance in fishing mortality is derived from the exceptional high 0.9 value of F at age 4 in 1994 (see section 3.6.4). The measurement error of the 1994 year class population number, assumed on a preliminary basis by RCT3, determined almost totally the variance of the 1997 SSB.

The cumulative probability distribution of the expected yield and the SSB are given in Figure 3.6.9. The 90% confidence intervals of the expected *status quo* yield in 1995 are 24,000 and 40,000 t respectively. The expected *status quo* yield in 1995 of 31,000 t is higher than the agreed TAC of 28,000 t. The probability that SSB in 1996 and 1997 will fall below its historically lowest observed value of 31,000 t is very small (less than 2 %).

3.6.9 Medium term projections

Medium term predictions were made for a period of 10 years to estimate percentiles of the distribution of the predicted yields, SSB and recruitment at a *status quo* level of fishing mortality and for a level of 0.8F *status quo* assuming no stock-recruitment. The results are presented in Figures 3.6.10 and 3.6.11. The model was run with 500 simulations. With *status quo* assumption, using bootstrap in the stock/recruitment model, SSB stabilized from 1998 onwards giving a 5% percentile of about 25,000 t in 2004. Giving the assumption of a 20% reduction in fishing mortality, SSB seems to stabilize at 30,000 t in 2004. It should be noted that assumptions of the 1994 year class, dominant in forward projecting SSB's (Figure 3.6.8), are made from RCT3 estimates with recruit indices which are preliminary and may be replaced by ACFM at the November meeting.

3.6.10 Long term considerations

The SPLIR model (Beek, 1994), has been used to estimate the probability that SSB will decrease below a certain level in the long term. Basically the model estimates the variability on the yield- and biomass-per-recruit curves due to the observed variability in recruitment. The model was run over 500 simulations.

The results are shown in Figure 3.6.12. At the present level of fishing mortality ($F_{(2-8)}$=0.498) the probability that the spawning stock will be below the level of Mbal (35,000 t) in any year in the long term is about 0.25. If the fishery mortality is reduced to 80% of the present level, this probability that it happens will reduce to 0.10. The distribution of expected yields is almost the same for all levels of fishing mortality. This corresponds to the flat topped yield/recruit curve, which is typical for this stock (Figure 3.6.6).

3.6.11 Comments on the assessment

The consistency of this assessment and previous assessment is shown in the quality control diagrams (Tables 3.6.17). The quality control diagrams show there is a tendency to revise F downwards, although the present assessment shows a slightly upwards revision for the recent years. The 1993 fishing mortality being submitted to a more substantial (11%) revision.

In general there is a lack of reliable effort and CPUE data. The effort of the only commercial fleet, used in the tuning is from a mixed fishery on plaice and sole and contains a certain proportion of effort exclusively directed to plaice. Changes in the directivity of this fishery towards one of both species or other species have been observed pending on the availability of the species (catch rates, catch restrictions) but cannot be quantified. The lower level in catchability in the last 5-7 years can be explained by a change in the distribution of this fleet induced by the plaice box. The plaice box covers significant spawning areas for sole in the second quarter, where these fish aggregate. These spawning areas were important fishing areas for the beam trawl fleet of vessels >300HP, the largest component in the sole fishery. Since the introduction of the plaice box the area is prohibited for these vessels and their effort has been directed elsewhere.

Other CPUE and effort series, (Table 3.6.18) could not be used either because they were biased by national restrictions in the amount of sole allowed to land by trip or because they were based on estimates in local areas. The historical trends in these series do not correspond at all with the converged trends in the assessment.

In the past, weights at age of sole have shown significant trends. In the mid-sixties and early seventies a significant increase of weight at age (about 40%) has been observed. This increase of w.a.a. has been explained by an increase in growth. Investigations (Millner et al., in press) demonstrate that in recent years a relatively small, but probably significant decrease in weight at age has been observed in sole as well as in plaice. The decrease in weight at age has continued in 1993 and even more in 1994. The reasons for these changes are not fully understood yet. The short term forecasts takes account of the change in weight at age by assuming the mean weight at age of the last 3 years. The medium- and long-term models, used by the Working Group do not take account for a possible further decrease, and should therefore be considered with necessary caution.

It should also be noted that calculations for converting gutted weight to fresh weight are differently done for the Netherlands data than for the other countries. The conversion factor used by all other countries, and management is 1.04. For the Dutch data, a factor of 1.11 was used throughout the time series. This implies that the conversion of SSB to a TAC is inconsistent with the factors used to convert whole weight to gutted weight in the database.

Taken into account the 70% contribution of the Netherlands landings to the international landings, a reduction of 4.4% should be applied for conversion of SSB to TAC if TAC's are to be consistent with the forecast.

3.6.12 Evaluation of the usefulness of quarterly International Bottom Trawl Surveys in the assessment

The gear used in the quarterly International Bottom Trawl Surveys does not catch significant amounts of sole and therefore the surveys were of no value in this assessment.

3.6.13 Management considerations

Apart from changes in technical measures, such as changes in the minimum mesh size, closed areas and closed seasons, which are directed to changes in the exploitation pattern or the protection of certain stock components, most management advice given by ACFM relates to changes in the level of fishing mortality. Many heavily exploited commercial stocks require a reduction in the level of fishing mortality, either to maintain these within historically observed safe levels or to improve the expected yields. The most obvious way to achieve a reduction in fishing mortality is a reducing the fishing effort.

In the case of sole it is obvious that total effort has increased significantly in the last 20 years while the fishing mortality shows only a minor increase. The problem clearly needs to be investigated in much more detail. Studies on this problem should be encouraged. In the mean time, the observed lack in the relation between F and effort, should be kept in mind when it is tried to achieve a reduction in fishing mortality by means of a reduction in effort.

Table 3.6.1 Nominal catch (tonnes) of SOLE in Sub-area IV and landings as estimated by the Working Group, 1982-1994

Year	Belgium	Denmark	France	Germany Fed. Rep.	Netherlands	UK (Engl. & Wales)	Other countries	Total reported	Unallocated landings	Grand Total
1982	1,927	522	686	290	17,749	403		21,577	2	21,579
1983	1,740	730	332	619	16,101	435		19,957	4,970	24,927
1984	1,771	818	400	1,034	14,330	586	1	18,940	7,899	26,839
1985	2,390	692	875	303	14,897	774	3	19,934	4,313	24,247
1986	1,833	443	296	155	9,558	647	2	12,934	5,267	18,201
1987	1,644	342	318	210	10,635	676	4	13,829	3,539	17,368
1988	1,199	616	487	452	9,841	740	28	13,363	8,227	21,590
1989	1,596	1,020	312	864	9,620	966	65	14,443	7,378	21,821
1990	2,389	1,428	352	2,296	18,202	1,484	276	26,427	8,706	35,133
1991	2,977	1,307	465	2,107	18,758	1,605	361	27,580	5,955	33,535
1992	2,058	1,359	548	1,880	18,601	1,237	321	26,004	3,345	29,349
1993	2,783	1,661	484	1,379	22,015	1,131	318	29,771	1,657	31,428
1994	2,935	1,802	498	1,744	22,874	1,137	353	31,343	1,326	32,669

all landings reported to ICES
unallocated landings estimated by the Working Group
1994 data are provisional
No data on discards available

Table 3.6.2

Run title : Sole in IV (run: XS1/002)

At 3-Oct-95 19:36:22

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
1,	165,	373,	92,	10,	115,	837,	117,	968,	53,	702,
2,	16618,	9351,	29208,	13187,	46140,	12023,	13217,	6875,	49806,	7455,
3,	43213,	18494,	21703,	47140,	18211,	103898,	25468,	44442,	16837,	86161,
4,	20286,	17703,	9210,	15248,	22583,	9779,	77535,	16211,	31340,	13716,
5,	9403,	7745,	6623,	4400,	4700,	9360,	6666,	37758,	13856,	18589,
6,	3556,	5522,	3133,	3890,	1695,	3824,	3842,	2472,	23921,	5664,
7,	209,	2272,	1527,	1554,	1455,	1164,	1829,	3064,	1491,	11149,
8,	379,	110,	892,	898,	655,	1273,	760,	790,	1214,	461,
9,	637,	282,	94,	526,	467,	604,	743,	428,	489,	916,
10,	200,	620,	114,	38,	240,	268,	325,	478,	194,	278,
11,	192,	355,	176,	34,	45,	324,	329,	175,	305,	85,
12,	189,	173,	142,	86,	36,	59,	386,	242,	109,	213,
13,	94,	126,	69,	42,	49,	28,	18,	143,	84,	83,
14,	33,	105,	56,	10,	27,	63,	16,	7,	116,	44,
+gp,	267,	305,	167,	111,	95,	215,	169,	255,	109,	245,
TOTALNUM,	95441,	63536,	73206,	87174,	96513,	143719,	131420,	114308,	139924,	145761,
TONSLAND,	24248,	18200,	17367,	21590,	21821,	35133,	33535,	29349,	31428,	32669,
SOPCOF %,	99,	99,	99,	100,	99,	99,	98,	98,	99,	99,

Table 3.6.3

Run title : Sole in IV (run: XS1/002)

At 3-Oct-95 19:36:33

Table 2 Catch weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
1,	.1220,	.1350,	.1390,	.1270,	.1180,	.1240,	.1270,	.1460,	.0970,	.1430,
2,	.1870,	.1790,	.1860,	.1750,	.1730,	.1820,	.1850,	.1770,	.1670,	.1810,
3,	.2160,	.2130,	.2050,	.2170,	.2160,	.2260,	.2090,	.2130,	.1950,	.2020,
4,	.2880,	.2990,	.2710,	.2700,	.2880,	.2900,	.2630,	.2590,	.2390,	.2280,
5,	.3570,	.3570,	.3530,	.3530,	.3350,	.3680,	.3140,	.2990,	.2640,	.2570,
6,	.4270,	.4070,	.3740,	.4280,	.3740,	.3900,	.4280,	.3800,	.3010,	.3000,
7,	.4470,	.4850,	.4280,	.4830,	.4560,	.4010,	.4340,	.4100,	.3380,	.3170,
8,	.5440,	.5430,	.4800,	.5190,	.4900,	.4970,	.4550,	.4590,	.4420,	.4320,
9,	.6120,	.5680,	.3800,	.5580,	.4720,	.4570,	.5050,	.4840,	.4930,	.4110,
10,	.6340,	.5360,	.5770,	.5940,	.5090,	.5640,	.5480,	.5270,	.6220,	.4130,
11,	.5090,	.5750,	.6370,	.8070,	.6810,	.6220,	.5130,	.5900,	.5630,	.5160,
12,	.6560,	.6330,	.6120,	.7140,	.6300,	.5170,	.5080,	.4710,	.5870,	.4810,
13,	.7670,	.6310,	.6590,	.7540,	.7110,	.5710,	.8190,	.6100,	.6390,	.6690,
14,	.8010,	.7880,	.7260,	.7710,	.6360,	.4610,	.7420,	.7760,	.6080,	.6060,
+gp,	.6800,	.7150,	.6980,	.6940,	.7290,	.6300,	.5520,	.6390,	.6400,	.5590,
SOPCOFAC,	.9898,	.9936,	.9932,	.9990,	.9854,	.9901,	.9837,	.9848,	.9887,	.9885,

Table 3.6.4

Run title : Sole in IV (run: XS1/002)

At 3-Oct-95 19:36:48

Table 3 Stock weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
1,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,	.0500,
2,	.1270,	.1330,	.1540,	.1330,	.1330,	.1480,	.1380,	.1560,	.1280,	.1430,
3,	.1850,	.1910,	.1920,	.1930,	.1950,	.2030,	.1830,	.1950,	.1820,	.1740,
4,	.2670,	.2780,	.2590,	.2600,	.2900,	.2920,	.2530,	.2590,	.2270,	.2090,
5,	.3240,	.3440,	.3490,	.3350,	.3480,	.3560,	.3000,	.3080,	.2620,	.2570,
6,	.3810,	.4230,	.3810,	.4080,	.3390,	.4380,	.4060,	.3990,	.2930,	.3260,
7,	.3800,	.4940,	.4050,	.4170,	.4100,	.3910,	.4370,	.4060,	.3390,	.3490,
8,	.6260,	.4870,	.4570,	.4720,	.4750,	.4860,	.5010,	.4700,	.4720,	.4020,
9,	.5540,	.5870,	.3080,	.4850,	.4180,	.4710,	.5510,	.4950,	.4200,	.4930,
10,	.5890,	.5460,	.5120,	.4550,	.4620,	.4960,	.4300,	.5440,	.5340,	.3410,
11,	.5170,	.6810,	.6240,	.8290,	.7040,	.6820,	.6400,	.4880,	.5590,	.4330,
12,	.7340,	.6450,	.5800,	.6550,	.7870,	.5500,	.6400,	.4420,	.5050,	.5190,
13,	.7400,	.7370,	.5720,	.5350,	.7160,	.7890,	.4300,	.5780,	.6760,	.4800,
14,	.6420,	.9390,	.6900,	.8470,	.6160,	.4580,	1.1090,	.6720,	.5740,	.6890,
+gp,	.6730,	.8870,	.6810,	.6870,	.7300,	.7490,	.6500,	.6280,	.6620,	.5050,

Table 3.6.5 Sole in the North Sea (Divisions IV) Tuning Data.

Netherlands All Fleets

Year	Effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1979	44.9	1.0	7721.2	35400.6	12904.4	2096.5	2657.4	1490.0	641.6	177.2	323.3	104.9	85.5	77.0	53.7	476.1
1980	45.0	462.1	938.3	11061.0	14294.5	4914.8	938.1	1731.7	1133.1	214.3	17.0	347.8	16.5	32.5	23.7	432.2
1981	46.3	391.2	26036.0	2756.0	5720.5	6094.5	2265.5	586.6	531.3	439.4	98.9	15.3	102.4	56.9	4.4	173.2
1982	57.3	2572.0	24290.1	38683.0	1085.1	2638.3	3214.2	961.1	234.8	352.9	287.6	80.2	41.7	157.3	7.9	141.1
1983	65.6	381.0	31274.7	36706.2	16386.3	375.1	768.9	1117.8	531.2	237.5	168.1	338.6	15.0	2.0	157.6	143.2
1984	70.8	186.7	26976.3	37398.3	18212.1	6529.0	301.2	492.0	633.5	321.8	123.7	130.9	90.3	6.4	14.5	155.4
1985	70.3	126.2	12923.7	34685.4	16979.4	7239.6	2536.8	146.5	285.1	426.8	84.9	68.7	113.3	61.9	9.1	134.5
1986	68.2	354.6	8027.0	13755.0	13809.8	6353.7	4342.4	1712.2	71.8	223.4	405.6	211.1	124.6	73.4	88.5	247.6
1987	68.5	73.7	23918.9	18282.7	7081.1	5313.1	2608.3	1095.7	566.4	57.0	78.0	79.7	80.1	36.4	32.0	123.4
1988	76.3	1.0	12191.9	40595.2	12448.9	2982.9	2955.6	1274.8	652.4	384.5	30.4	25.4	42.7	26.1	3.2	60.9
1989	61.6	1.0	40284.3	13165.6	17489.4	2688.9	1099.4	1134.4	409.4	333.9	161.6	8.9	22.7	16.2	10.0	40.0
1990	71.4	119.3	9071.1	84629.7	7242.0	6586.7	1965.0	634.6	819.2	375.9	137.6	134.1	42.5	10.1	12.6	138.2
1991	68.5	40.0	7336.6	17182.4	59754.0	4638.3	2137.6	682.7	312.1	392.3	156.6	98.4	180.5	6.3	6.0	48.1
1992	71.1	833.9	5055.0	34088.9	11138.4	29622.1	1458.1	2063.2	447.7	216.0	272.3	74.5	170.3	74.4	3.9	107.5
1993	76.9	1.0	39284.5	10948.0	24132.0	9625.4	18624.0	887.1	811.5	236.1	66.4	186.3	50.2	41.6	59.1	21.8
1994	81.1	531.2	5389.9	69878.8	7411.7	13010.4	3104.8	8932.9	190.0	524.2	175.9	25.9	158.5	25.2	20.1	149.5

Tridens sns survey

Year	Effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4
1970	1	4938	745	204	31
1971	1	613	1961	99	7
1972	1	1410	341	161	0.1
1973	1	4686	905	73	35
1974	1	1924	397	69	0.1
1975	1	597	887	174	44
1976	1	1413	79	187	70
1977	1	3724	762	77	85
1978	1	1552	1379	267	27
1979	1	104	388	325	60
1980	1	4483	80	99	45
1981	1	3739	1411	51	13
1982	1	5098	1124	231	7
1983	1	2640	1137	107	43
1984	1	2359	1081	307	102
1985	1	2151	709	159	59
1986	1	3791	465	67	30
1987	1	1890	955	59	15
1988	1	11227	594	284	81
1989	1	3052	5369	248	50
1990	1	2900	1078	907	100
1991	1	1265	2515	527	607
1992	1	11081	114	319	194
1993	1	1351	3489	46	166
1994	1	559	475	943	10

Solea survey

Year	Effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1980	10	38.0	276.0	261.0	150.0	13.0	35.0	18.0	5.0	1.0
1981	10	436.0	27.0	76.0	46.0	22.0	4.0	6.0	5.0	2.0
1982	10	171.0	484.0	14.0	53.0	29.0	21.0	4.0	10.0	4.0
1983	10	740.0	500.0	233.0	8.0	18.0	11.0	9.0	10.0	2.0
1984	10	131.0	844.0	344.0	149.0	5.0	15.0	15.0	8.0	2.0
1985	10	49.0	328.0	404.0	90.0	30.0	2.0	3.0	2.0	1.0
1986	10	71.0	95.0	84.0	71.0	23.0	6.0	0.0	2.0	1.0
1987	10	118.0	173.0	74.0	34.0	18.0	5.0	2.0	0.0	0.0
1988	10	42.0	163.0	79.0	15.0	11.0	9.0	2.0	1.0	0.0
1989	10	244.0	249.0	214.0	46.0	12.0	10.0	9.0	2.0	1.0
1990	10	70.0	526.0	78.0	28.0	8.0	2.0	1.0	1.0	0.0
1991	10	95.0	341.0	872.0	100.0	69.0	11.0	4.0	2.0	4.0
1992	10	12.0	258.0	112.0	256.0	36.0	8.0	7.0	0.0	1.0
1993	10	154.7	89.2	824.7	293.6	338.3	25.8	8.8	5.6	0.6
1994	10	46.0	1144.0	68.0	246.0	67.0	157.0	9.0	8.0	2.0

BTS survey

Year	Effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7
1985	1	2.372	6.021	3.959	1.612	0.593	0.216	0.019
1986	1	5.935	4.883	1.555	1.037	0.458	0.225	0.109
1987	1	6.101	9.842	2.497	0.768	0.551	0.192	0.148
1988	1	70.609	11.138	3.060	0.802	0.160	0.157	0.088
1989	1	8.021	60.486	3.199	4.089	0.530	0.189	0.144
1990	1	18.991	19.400	19.486	0.950	0.693	0.229	0.084
1991	1	3.328	17.372	4.597	9.119	0.260	0.481	0.132
1992	1	67.816	24.403	9.134	2.484	3.442	0.115	0.174
1993	1	4.954	24.505	2.652	3.930	1.670	3.266	0.029

Table 3.6.6

```
Lowestoft VPA Version 3.1

   3-Oct-95  19:35:15

Extended Survivors Analysis

Sole in IV (run: XS1/002)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/sol_nsea/FLEET.002

Catch data for  10 years. 1985 to 1994. Ages  1 to  15.

     Fleet,           First, Last, First, Last, Alpha,  Beta
                ,      year, year,  age ,  age
BTS: >>BTS<< (Catch:,  1985, 1994,   1,     7,   .670,   .750
NETHA: >>NETH ALL FL,  1985, 1994,   1,    14,   .000,  1.000
SOLEA: >>Solea surve,  1985, 1994,   2,    10,   .330,   .420
TRIDN: >>Tridens SNS,  1985, 1994,   1,     4,   .670,   .750


Time series weights :

     Tapered time weighting applied
     Power =    3 over  10 years


Catchability analysis :

     Catchability dependent on stock size for ages <    3

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  3


     Catchability independent of age for ages >=    7


Terminal population estimation :

     Survivor estimates shrunk towards the mean F
     of the final   5 years or the   5 oldest ages.

     S.E. of the mean to which the estimates  are shrunk =    .500

     Minimum standard error for population
     estimates derived from each fleet =    .300

     Prior weighting not applied


Tuning converged after   28 iterations


Regression weights
      ,  .020,  .116,  .284,  .482,  .670,  .820,  .921,  .976,  .997, 1.000


Fishing mortalities
   Age,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994

     1,  .002,  .002,  .001,  .000,  .001,  .005,  .002,  .003,  .001,  .006
     2,  .313,  .141,  .236,  .237,  .124,  .130,  .086,  .137,  .164,  .108
     3,  .717,  .601,  .493,  .644,  .526,  .399,  .395,  .403,  .504,  .416
     4,  .753,  .644,  .604,  .683,  .652,  .529,  .519,  .416,  .490,  .893
     5,  .585,  .643,  .468,  .576,  .406,  .546,  .744,  .456,  .668,  .535
     6,  .425,  .727,  .516,  .490,  .403,  .599,  .400,  .602,  .519,  .562
     7,  .339,  .468,  .395,  .463,  .303,  .473,  .569,  .569,  .800,  .431
     8,  .454,  .268,  .299,  .378,  .320,  .418,  .573,  .456,  .409,  .543
     9,  .401,  .640,  .343,  .258,  .307,  .486,  .408,  .656,  .503,  .546
    10,  .237,  .757,  .512,  .202,  .161,  .258,  .465,  .444,  .624,  .528
    11,  .469,  .743,  .439,  .249,  .346,  .301,  .511,  .434,  .501,  .544
    12,  .499,  .906,  .668,  .353,  .402,  .912,  .621,  .780,  .469,  .696
    13,  .350,  .649, 1.049,  .372,  .310,  .553,  .697,  .434,  .604,  .701
    14,  .396,  .727,  .595,  .353,  .386,  .727,  .629,  .568,  .669,  .655
```

Table 3.6.6 Continued

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8
1985	8.26E+04	6.50E+04	8.88E+04	4.03E+04	2.23E+04	1.08E+04	7.64E+02	1.09E+03	2.03E+03	9.97E+02
1986	1.62E+05	7.46E+04	4.30E+04	3.92E+04	1.72E+04	1.12E+04	6.40E+03	4.92E+02	6.27E+02	1.23E+03
1987	7.26E+04	1.46E+05	5.86E+04	2.14E+04	1.86E+04	8.17E+03	4.92E+03	3.63E+03	3.41E+02	2.99E+02
1988	4.59E+05	6.56E+04	1.04E+05	3.24E+04	1.06E+04	1.06E+04	4.41E+03	3.00E+03	2.43E+03	2.19E+02
1989	1.14E+05	4.15E+05	4.68E+04	4.96E+04	1.48E+04	5.37E+03	5.86E+03	2.51E+03	1.86E+03	1.70E+03
1990	1.88E+05	1.03E+05	3.32E+05	2.50E+04	2.34E+04	8.92E+03	3.25E+03	3.91E+03	1.65E+03	1.24E+03
1991	6.27E+04	1.69E+05	8.21E+04	2.01E+05	1.34E+04	1.22E+04	4.43E+03	1.83E+03	2.33E+03	9.19E+02
1992	3.84E+05	5.66E+04	1.41E+05	5.01E+04	1.08E+05	5.74E+03	7.43E+03	2.27E+03	9.35E+02	1.40E+03
1993	8.44E+04	3.47E+05	4.47E+04	8.51E+04	2.99E+04	6.21E+04	2.85E+03	3.81E+03	1.30E+03	4.39E+02
1994	1.26E+05	7.63E+04	2.66E+05	2.44E+04	4.72E+04	1.39E+04	3.35E+04	1.16E+03	2.29E+03	7.12E+02

Estimated population abundance at 1st Jan 1995

.00E+00, 1.14E+05, 6.20E+04, 1.59E+05, 9.04E+03, 2.50E+04, 7.15E+03, 1.97E+04, 6.08E+02, 1.20E+03,

Taper weighted geometric mean of the VPA populations:

1.43E+05, 1.32E+05, 1.10E+05, 5.03E+04, 2.80E+04, 1.22E+04, 6.14E+03, 2.36E+03, 1.54E+03, 7.97E+02,

Standard error of the weighted Log(VPA populations) :

.7225, .7781, .8059, .7875, .8022, .8478, .8790, .5121, .5246, .6653,

YEAR	AGE 11	12	13	14
1985	5.39E+02	5.05E+02	3.35E+02	1.06E+02
1986	7.12E+02	3.05E+02	2.78E+02	2.14E+02
1987	5.21E+02	3.06E+02	1.12E+02	1.31E+02
1988	1.62E+02	3.04E+02	1.42E+02	3.54E+01
1989	1.62E+02	1.14E+02	1.93E+02	8.86E+01
1990	1.31E+03	1.04E+02	6.93E+01	1.28E+02
1991	8.65E+02	8.77E+02	3.77E+01	3.60E+01
1992	5.22E+02	4.70E+02	4.27E+02	1.70E+01
1993	8.14E+02	3.06E+02	1.95E+02	2.50E+02
1994	2.13E+02	4.46E+02	1.73E+02	9.63E+01

Estimated population abundance at 1st Jan 1995

3.80E+02, 1.12E+02, 2.01E+02, 7.77E+01,

Taper weighted geometric mean of the VPA populations:

4.79E+02, 3.17E+02, 1.42E+02, 7.27E+01,

Standard error of the weighted Log(VPA populations) :

.8103, .7471, .8150, .9624,

Table 3.6.6 Continued

Log catchability residuals.

Fleet : BTS: >>BTS<< (Catch:

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	-.42	-.52	.29	-.04	.01	.04	.07	.11	.01	-.22
2	-.84	-1.54	-.90	.11	1.00	.47	-.27	1.47	-.31	-1.53
3	-.03	-.33	-.24	-.50	.26	.02	-.04	.12	.10	-.02
4	.11	-.38	-.10	-.42	.76	-.10	.07	.09	.07	-.37
5	-.16	-.12	-.14	-.73	.01	-.08	-.36	-.08	.64	.24
6	-.24	-.02	-.01	-.49	.31	.14	.42	-.11	.79	-1.14
7	.03	-.26	.26	-.11	-.01	.16	.37	.13	-.54	-.05
8	No data for this fleet at this age									
9	No data for this fleet at this age									
10	No data for this fleet at this age									
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7
Mean Log q	-9.4040	-9.6309	-9.8863	-10.2086	-10.3169
S.E(Log q)	.2046	.3514	.4038	.6599	.3037

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.62	3.734	10.33	.96	10	.17	-9.37
2	1.70	-1.059	6.70	.35	10	1.18	-8.79

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.03	-.267	9.33	.94	10	.23	-9.40
4	.85	.863	9.81	.89	10	.31	-9.63
5	.83	.908	9.95	.87	10	.34	-9.89
6	.78	.794	10.03	.76	10	.54	-10.21
7	.96	.234	10.26	.90	10	.32	-10.32

Table 3.6.6 Continued

Fleet : NETHA: >>NETH ALL FL

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	1.73	1.99	1.41	-4.32	-2.74	.84	1.02	1.84	-2.63	2.44
2	.91	.27	.68	.73	.19	.01	-.67	.06	.15	-.32
3	.55	.33	.25	.43	.27	-.03	-.19	-.08	-.10	-.13
4	.45	.26	.17	.25	.36	-.04	.03	-.35	-.15	.04
5	.18	.36	.02	-.05	-.35	.00	.34	-.07	.11	-.15
6	-.03	.63	.35	.09	-.04	-.03	-.31	.12	.17	-.16
7	-.26	.16	-.06	.13	-.13	-.20	-.35	.20	.34	-.03
8	.10	-.54	-.46	-.20	-.30	-.15	-.25	-.19	-.21	-.46
9	-.14	.53	-.37	-.57	-.21	-.04	-.33	.06	-.33	-.13
10	-1.12	.50	.15	-.73	-.91	-.86	-.29	-.21	-.46	-.06
11	-.61	.39	-.41	-.59	-1.37	-.92	-.68	-.52	-.10	-.76
12	-.03	.78	.23	-.65	-.06	.74	-.04	.56	-.45	.37
13	-.29	.23	.61	-.37	-.97	-.45	-.21	-.32	-.12	-.52
14	-1.04	.72	.12	-1.09	-.64	-.77	-.24	.01	.01	-.18

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9	10	11	12
Mean Log q	-5.3612	-5.1735	-5.2301	-5.4216	-5.4335	-5.4335	-5.4335	-5.4335	-5.4335	-5.4335
S.E(Log q)	.2138	.2308	.2160	.2141	.2482	.3197	.3041	.5857	.8113	.5113

Age	13	14
Mean Log q	-5.4335	-5.4335
S.E(Log q)	.5135	.5318

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	.88	.072	12.49	.08	10	2.77	-12.58
2	.96	.155	6.80	.77	10	.48	-6.59

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.08	-.631	4.84	.93	10	.25	-5.36
4	1.05	-.349	4.88	.92	10	.27	-5.17
5	1.08	-.559	4.85	.93	10	.25	-5.23
6	.96	.318	5.57	.95	10	.23	-5.42
7	1.02	-.120	5.38	.92	10	.28	-5.43
8	.86	1.963	6.00	.98	10	.09	-5.70
9	1.16	-.726	5.35	.82	10	.27	-5.62
10	1.10	-.343	5.76	.72	10	.46	-5.84
11	.83	.906	6.09	.87	10	.35	-6.08
12	1.11	-.324	5.25	.66	10	.60	-5.30
13	1.06	-.258	5.82	.83	10	.41	-5.77
14	.97	.131	5.69	.85	10	.46	-5.73

Table 3.6.6 Continued

Fleet : SOLEA: >>Solea surve

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	No data for this fleet at this age									
2	.50	.63	.43	.33	-.01	.29	.05	-.65	-.22	.22
3	.42	-.14	.11	-.47	.71	-.55	.42	-.40	-.28	.46
4	1.05	-.53	-.07	-.39	.17	-.20	.13	-.57	.92	-.18
5	.12	.17	-.72	-.93	-.21	-1.11	.80	-.46	1.04	.36
6	-.20	-.39	-.40	-1.16	-.43	-1.26	.50	.68	.51	.41
7	.10	-.88	-.82	-.10	-.34	-1.30	.13	-.70	1.52	.72
8	.19	99.99	-1.47	-1.25	.41	-2.20	.01	.31	.00	1.27
9	-.85	.41	99.99	-1.78	-.80	-1.31	-.99	99.99	.66	.47
10	-.90	-.91	99.99	99.99	-1.46	99.99	.66	-1.16	-.44	.24
11	No data for this fleet at this age									
12	No data for this fleet at this age									
13	No data for this fleet at this age									
14	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9	10
Mean Log q	-8.0161	-7.6377	-7.6785	-7.7931	-8.1850	-8.1850	-8.1850	-8.1850
S.E(Log q)	.4956	.5132	.8259	.7833	.9772	1.1746	1.1079	.9728

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
2	.87	.549	10.06	.81	10	.41	-9.81

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.15	-.453	7.47	.68	10	.62	-8.02
4	.77	1.089	8.38	.84	10	.39	-7.64
5	1.04	-.083	7.57	.46	10	.96	-7.68
6	.78	.661	8.15	.68	10	.65	-7.79
7	.87	.292	8.26	.52	10	.93	-8.18
8	-1.08	-2.406	7.20	.24	9	.91	-8.34
9	-3.56	-.776	3.59	.01	8	3.72	-8.63
10	7.28	-1.019	19.73	.01	7	6.29	-8.57

Table 3.6.6 Continued

```
Fleet : TRIDN: >>Tridens SNS

 Age  ,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994
    1 ,   .47,   .26,   .49,   .11,   .43,  -.11,   .31,   .28,   .07, -1.06
    2 ,   .56,   .09,  -.09,   .41,  -.11,   .28,   .30,  -.52,  -.18,   .06
    3 ,  -.24,  -.46,  -.97,   .13,   .71,  -.04,   .81,  -.22,  -.94,   .23
    4 ,  -.07,  -.80,  -.91,   .41,  -.52,   .77,   .48,   .66,   .03, -1.25
    5 , No data for this fleet at this age
    6 , No data for this fleet at this age
    7 , No data for this fleet at this age
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
   10 , No data for this fleet at this age
   11 , No data for this fleet at this age
   12 , No data for this fleet at this age
   13 , No data for this fleet at this age
   14 , No data for this fleet at this age


Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

   Age ,        3,        4
Mean Log q,   -5.5091,   -5.8477,
S.E(Log q),     .6501,     .7853,



Regression statistics :

Ages with q dependent on year class strength

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 1,     .82,     .509,      5.45,     .65,     10,     .59,   -4.03,
 2,     .63,    1.878,      7.35,     .85,     10,     .36,   -4.70,

Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 3,     .86,     .425,      6.36,     .68,     10,     .61,   -5.51,
 4,     .72,     .859,      7.22,     .69,     10,     .58,   -5.85,


Terminal year survivor and F summaries :

Age  1   Catchability dependent on age and year class strength

Year class = 1993

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
BTS: >>BTS<< (Catch:,    91556.,   .300,       .000,    .00,   1,  .591,     .007
NETHA: >>NETH ALL FL,  1309455.,  3.167,       .000,    .00,   1,  .005,     .001
SOLEA: >>Solea surve,        1.,   .000,       .000,    .00,   0,  .000,     .000
TRIDN: >>Tridens SNS,    39562.,   .722,       .000,    .00,   1,  .102,     .017

  P shrinkage mean  ,    131935.,    .78,,,,                        .088,     .005

  F shrinkage mean  ,    302434.,    .50,,,,                        .214,     .002

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,    ,   Ratio,
   113657.,       .23,      .35,    5,  1.503,   .006
```

Table 3.6.6 Continued

Age 2 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	59254.,	.295,	.297,	1.01,	2, .331,	.113
NETHA: >>NETH ALL FL,	42360.,	.545,	.374,	.69,	2, .097,	.155
SOLEA: >>Solea surve,	77007.,	.450,	.000,	.00,	1, .142,	.088
TRIDN: >>Tridens SNS,	66008.,	.337,	.003,	.01,	2, .253,	.102
P shrinkage mean ,	109518.,	.81,,,,			.049,	.063
F shrinkage mean ,	51802.,	.50,,,,			.128,	.128

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
61988.,	.17,	.10,	9,	.602,	.108

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	163929.,	.211,	.059,	.28,	3, .368,	.405
NETHA: >>NETH ALL FL,	149215.,	.266,	.127,	.48,	3, .243,	.438
SOLEA: >>Solea surve,	176602.,	.355,	.338,	.95,	2, .130,	.381
TRIDN: >>Tridens SNS,	158913.,	.320,	.150,	.47,	3, .152,	.416
F shrinkage mean ,	145407.,	.50,,,,			.107,	.447

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
158958.,	.13,	.06,	12,	.430,	.416

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	8555.,	.193,	.168,	.87,	4, .312,	.926
NETHA: >>NETH ALL FL,	9018.,	.205,	.050,	.25,	4, .316,	.895
SOLEA: >>Solea surve,	6559.,	.328,	.135,	.41,	3, .115,	1.095
TRIDN: >>Tridens SNS,	4885.,	.323,	.301,	.93,	4, .100,	1.300
F shrinkage mean ,	18988.,	.50,,,,			.157,	.523

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
9044.,	.13,	.12,	16,	.936,	.893

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	28264.,	.189,	.045,	.24,	5, .298,	.486
NETHA: >>NETH ALL FL,	21218.,	.177,	.064,	.36,	5, .400,	.606
SOLEA: >>Solea surve,	33193.,	.302,	.286,	.95,	4, .108,	.427
TRIDN: >>Tridens SNS,	27347.,	.303,	.122,	.40,	4, .078,	.499
F shrinkage mean ,	23206.,	.50,,,,			.116,	.566

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
25001.,	.11,	.06,	19,	.521,	.535

Table 3.6.6 Continued

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	6921.,	.205,	.261,	1.27,	6, .226,	.576
NETHA: >>NETH ALL FL,	6333.,	.170,	.073,	.43,	6, .484,	.616
SOLEA: >>Solea surve,	9170.,	.332,	.252,	.76,	5, .097,	.462
TRIDN: >>Tridens SNS,	11498.,	.316,	.124,	.39,	4, .048,	.384
F shrinkage mean ,	8169.,	.50,,,,			.145,	.507

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
7152.,	.12,	.08,	22,	.666,	.562

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	20243.,	.211,	.092,	.44,	7, .304,	.421
NETHA: >>NETH ALL FL,	20096.,	.162,	.046,	.28,	7, .488,	.424
SOLEA: >>Solea surve,	23825.,	.370,	.208,	.56,	6, .070,	.368
TRIDN: >>Tridens SNS,	21299.,	.374,	.140,	.38,	4, .022,	.404
F shrinkage mean ,	14646.,	.50,,,,			.117,	.545

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
19666.,	.12,	.05,	25,	.389,	.431

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	406.,	.240,	.096,	.40,	7, .181,	.733
NETHA: >>NETH ALL FL,	563.,	.186,	.140,	.76,	8, .548,	.576
SOLEA: >>Solea surve,	1601.,	.517,	.212,	.41,	7, .056,	.242
TRIDN: >>Tridens SNS,	1099.,	.417,	.094,	.23,	4, .008,	.336
F shrinkage mean ,	801.,	.50,,,,			.207,	.437

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
608.,	.15,	.09,	27,	.582,	.543

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	1381.,	.241,	.101,	.42,	7, .135,	.489
NETHA: >>NETH ALL FL,	1101.,	.166,	.064,	.39,	9, .622,	.583
SOLEA: >>Solea surve,	1254.,	.503,	.199,	.40,	8, .057,	.527
TRIDN: >>Tridens SNS,	987.,	.532,	.161,	.30,	4, .005,	.633
F shrinkage mean ,	1439.,	.50,,,,			.181,	.473

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1200.,	.14,	.05,	29,	.322,	.546

Table 3.6.6 Continued

Age 10 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	489.,	.264,	.092,	.35,	7, .095,	.433
NETHA: >>NETH ALL FL,	302.,	.180,	.045,	.25,	10, .576,	.628
SOLEA: >>Solea surve,	459.,	.564,	.162,	.29,	9, .074,	.455
TRIDN: >>Tridens SNS,	375.,	.728,	.324,	.45,	4, .002,	.533
F shrinkage mean ,	552.,	.50,,,,			.252,	.392

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
380.,	.17,	.06,	31,	.373,	.528

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	120.,	.293,	.123,	.42,	6, .059,	.515
NETHA: >>NETH ALL FL,	88.,	.217,	.098,	.45,	10, .483,	.653
SOLEA: >>Solea surve,	70.,	.714,	.124,	.17,	8, .044,	.770
TRIDN: >>Tridens SNS,	57.,	1.205,	.310,	.26,	3, .001,	.883
F shrinkage mean ,	155.,	.50,,,,			.413,	.420

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
112.,	.23,	.08,	28,	.355,	.544

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	189.,	.345,	.069,	.20,	5, .049,	.729
NETHA: >>NETH ALL FL,	201.,	.226,	.095,	.42,	10, .507,	.698
SOLEA: >>Solea surve,	64.,	.608,	.175,	.29,	8, .037,	1.421
TRIDN: >>Tridens SNS,	96.,	2.275,	.176,	.08,	2, .000,	1.133
F shrinkage mean ,	226.,	.50,,,,			.407,	.639

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
201.,	.24,	.07,	26,	.283,	.696

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	70.,	.432,	.016,	.04,	4, .020,	.752
NETHA: >>NETH ALL FL,	54.,	.259,	.072,	.28,	10, .500,	.898
SOLEA: >>Solea surve,	84.,	.696,	.324,	.47,	7, .022,	.662
TRIDN: >>Tridens SNS,	72.,	5.993,	.000,	.00,	1, .000,	.739
F shrinkage mean ,	115.,	.50,,,,			.457,	.522

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
78.,	.26,	.11,	23,	.431,	.701

Table 3.6.6 Continued

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1980

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, Scaled, Weights,	Estimated F
BTS: >>BTS<< (Catch:,	58.,	.590,	.048,	.08,	3, .007,	.546
NETHA: >>NETH ALL FL,	41.,	.299,	.097,	.33,	10, .470,	.709
SOLEA: >>Solea surve,	19.,	.991,	.115,	.12,	5, .005,	1.182
TRIDN: >>Tridens SNS,	1.,	.000,	.000,	.00,	0, .000,	.000
F shrinkage mean ,	50.,	.50,,,,			.518,	.606

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
45.,	.29,	.06,	19,	.209,	.655

Table 3.6.7

Run title : Sole in IV (run: XS1/002)

At 3-Oct-95 19:35:50

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
1,	.0021,	.0024,	.0013,	.0000,	.0011,	.0047,	.0020,	.0027,	.0007,	.0059,	.0031,
2,	.3128,	.1413,	.2361,	.2374,	.1243,	.1304,	.0856,	.1366,	.1638,	.1083,	.1362,
3,	.7171,	.6009,	.4932,	.6442,	.5258,	.3995,	.3947,	.4034,	.5044,	.4158,	.4412,
4,	.7533,	.6438,	.6040,	.6833,	.6518,	.5285,	.5192,	.4161,	.4898,	.8931,	.5996,
5,	.5854,	.6429,	.4678,	.5760,	.4064,	.5464,	.7438,	.4563,	.6684,	.5349,	.5532,
6,	.4245,	.7265,	.5163,	.4898,	.4029,	.5994,	.4002,	.6022,	.5189,	.5615,	.5609,
7,	.3393,	.4675,	.3951,	.4627,	.3028,	.4726,	.5692,	.5686,	.8001,	.4313,	.6000,
8,	.4543,	.2678,	.2993,	.3781,	.3203,	.4184,	.5726,	.4558,	.4085,	.5428,	.4690,
9,	.4012,	.6403,	.3425,	.2579,	.3067,	.4858,	.4082,	.6558,	.5026,	.5460,	.5681,
10,	.2369,	.7572,	.5121,	.2015,	.1606,	.2583,	.4651,	.4438,	.6240,	.5281,	.5319,
11,	.4690,	.7431,	.4388,	.2490,	.3456,	.3010,	.5107,	.4345,	.5007,	.5439,	.4930,
12,	.4995,	.9059,	.6682,	.3531,	.4018,	.9118,	.6208,	.7803,	.4693,	.6963,	.6486,
13,	.3497,	.6488,	1.0492,	.3722,	.3102,	.5535,	.6972,	.4343,	.6042,	.7011,	.5799,
14,	.3959,	.7273,	.5952,	.3527,	.3862,	.7272,	.6290,	.5679,	.6686,	.6546,	.6303,
+gp,	.3959,	.7273,	.5952,	.3527,	.3862,	.7272,	.6290,	.5679,	.6686,	.6546,	
FBAR 2- 8,	.5124,	.4987,	.4302,	.4959,	.3906,	.4422,	.4693,	.4341,	.5077,	.4982,	
FBAR 3-10,	.4890,	.5934,	.4538,	.4617,	.3847,	.4636,	.5091,	.5002,	.5646,	.5567,	

Table 3.6.8

Run title : Sole in IV (run: XS1/002)

At 3-Oct-95 19:35:50

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year)							Numbers*10**-3						
YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 85-92	AMST 85-92
AGE													
1,	82614,	161774,	72603,	458688,	114375,	188146,	62686,	384086,	84429,	126347,	(0,)[1]	148033,	190622,
2,	65042,	74595,	146025,	65607,	415029,	103382,	169445,	56609,	346615,	76344,	(113657,)[2]	108446,	136967,
3,	88756,	43045,	58602,	104345,	46819,	331644,	82107,	140748,	44683,	266253,	61988,	89702,	112008,
4,	40301,	39204,	21357,	32381,	49574,	25041,	201253,	50068,	85080,	24415,	158958,	43849,	57397,
5,	22309,	17169,	18634,	10564,	14795,	23375,	13356,	108348,	29883,	47172,	9044,	20994,	28569,
6,	10807,	11241,	8168,	10561,	5373,	8916,	12247,	5744,	62120,	13859,	25001,	8780,	9132,
7,	764,	6396,	4919,	4410,	5855,	3249,	4430,	7427,	2846,	33454,	7152,	4006,	4681,
8,	1091,	492,	3626,	2998,	2512,	3914,	1833,	2269,	3806,	1157,	19666,	1983,	2342,
9,	2026,	627,	341,	2432,	1859,	1650,	2331,	935,	1301,	2289,	608,	1276,	1525,
10,	997,	1227,	299,	219,	1700,	1238,	919,	1402,	439,	712,	1200,	826,	1000,
11,	539,	712,	521,	162,	162,	1310,	865,	522,	814,	213,	380,	486,	599,
12,	505,	305,	306,	304,	114,	104,	877,	470,	306,	446,	112,	303,	373,
13,	335,	278,	112,	142,	193,	69,	38,	427,	195,	173,	201,	154,	199,
14,	106,	214,	131,	35,	89,	128,	36,	17,	250,	96,	78,	72,	95,
+gp,	855,	616,	389,	391,	311,	435,	378,	616,	234,	533,	296,		
TOTAL,	317047,	357896,	336032,	693239,	658761,	692601,	552801,	759688,	663000,	593465,	398340,		

[1] Replaced by 183823 (RCT3 estimates)

[2] Replaced by 48341 (RCT3 estimates)

Table 3.6.9 SOLE NORTH SEA (IV) - Indices of recruitment (input data for RCT3)

Year class	VPA	INT-0	TR1S	INT-1	TR2S	TR3S	SOL3	NBTS1	NBTS2
1968	50588	-11	-11	-11	745	99	-11	-11	-11
1969	141484	-11	4938	-11	1961	161	-11	-11	-11
1970	41934	-11	613	-11	341	73	-11	-11	-11
1971	76952	-11	1410	-11	905	69	-11	-11	-11
1972	106433	-11	4686	-11	397	174	-11	-11	-11
1973	110793	-11	1924	-11	887	187	31.50	-11	-11
1974	41916	-11	597	1.49	79	77	16.30	-11	-11
1975	114189	167.88	1413	5.93	762	267	34.40	-11	-11
1976	140658	81.91	3724	6.97	1379	325	-11	-11	-11
1977	47100	32.31	1552	0.87	388	99	41.50	-11	-11
1978	11864	95.38	104	2.27	80	51	1.90	-11	-11
1979	155024	391.51	4483	-11	1411	231	76.10	-11	-11
1980	149585	401.63	3739	12.10	1124	107	77.10	-11	-11
1981	153576	293.04	5098	14.58	1137	307	147.10	-11	-11
1982	144519	340.58	2640	21.81	1081	159	77.80	-11	-11
1983	72080	109.40	2359	11.23	709	67	10.80	-11	602.1
1984	82614	194.20	2151	3.29	465	59	29.80	237.2	488.3
1985	161722	300.66	3791	11.62	955	284	24.60	593.5	984.2
1986	72600	72.36	1890	5.16	594	248	20.30	610.1	1113.8
1987	460105	534.21	11227	17.08	5369	907	66.90	7060.9	6048.6
1988	115286	61.73	3052	6.50	1078	527	86.40	802.1	1940
1989	186678	83.00	2900	8.72	2515	319	54.10	1899.1	1737.2
1990	63014	62.56	1265	11.21	114	46	11.30	332.8	2440.3
1991	386121	369.69	11081	11.87	3489	943	180.70	6781.6	2450.5
1992	-11	32.80	1351	10.38	475	-11	-11	495.4	507.7
1993	-11	30.02	559	4.05	-11	-11	-11	653.7	832.0
1994	-11	76.24	-11	-11	-11	-11	-11	2534.7	-11
1995	-11	-11	-11	-11	-11	-11	-11	-11	-11

INT-0	INT-1		International DFS survey
TR1S	TR2S	TR3S	TRIDENS" SNS coastal beam trawl survey
SOL3			SOLEA" beam trawl survey
NBTS1	NBTS2		ISIS" beam trawl survey

E:\acfm\wgnssk96\t369.xls

Table 3.6.10

SOLE NORTH SEA (IV)-VPA - **(1 Year olds)**
Analyses by RCT3 vers3.1 of data from file : S4RCT1.CSV

Data for 8 surveys over 28 years : 1968 - 1995
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Prediction
Yearclass = 1992										
INT-0,	1.59	3.61	1.08	.386	17	3.52	9.19	1.291	.022	9799
TR1S,,	.81	5.27	.28	.886	23	7.21	11.10	.302	.402	66171
INT-1	1.69	8.01	.86	.512	17	2.43	12.11	.951	.041	181680
TR2S	.83	6.04	.42	.771	24	6.17	11.14	.454	.178	68872
TR3S	estimates available to ACFM in November 95									
NBTS1	.62	7.59	.30	.881	8	6.21	11.42	.371	.266	91126
NBTS2	1.41	1.49	.87	.450	9	6.23	10.29	1.152	.028	29437
					VPA Mean =		11.51	.762	.063	99708
Yearclass = 1993										
INT-0,	1.59	3.61	1.08	.386	17	3.43	9.06	1.303	.027	8604
TR1S,,	.81	5.27	.28	.886	23	6.33	10.39	.313	.466	32533
INT-1	1.69	8.01	.86	.512	17	1.62	10.74	.958	.050	46166
TR2S	estimates available to ACFM in November 95									
NBTS1	.62	7.59	.30	.881	8	6.48	11.59	.366	.340	108012
NBTS2	1.41	1.49	.87	.450	9	6.73	10.99	1.077	.039	59278
					VPA Mean =		11.51	.762	.079	99708
Yearclass = 1994										
INT-0,	1.59	3.61	1.08	.386	17	4.35	10.50	1.204	.072	36316
TR1S,,	estimates available to ACFM in November 95									
INT-1	estimates available to ACFM in November 95									
NBTS1	.62	7.59	.30	.881	8	7.84	12.42	.372	.749	247707
					VPA Mean =		11.51	.762	.179	99708
Yearclass = 1995										
INT-0,	estimates available to ACFM in November 95									

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	72769	11.20	.19	.17	.76		
1993	53666	10.89	.21	.28	1.77		
1994	**183823**	**12.12**	**.32**	**.40**	**1.56**		
1995	No valid surveys						

Table 3.6.10 continued

SOLE NORTH SEA (IV)-VPA - **(2 YEAR olds)**
Analyses by RCT3 vers3.1 of data from file : S4RCT2.CSV

Data for 8 surveys over 28 years : 1968 - 1995
Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression
Forecast/Hindcast variance correction used.

Survey/ Series	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Pediction
Yearclass = 1992										
INT-0,	1.58	3.52	1.07	.386	17	3.52	9.09	1.288	.022	8866
TR1S,,	.81	5.17	.28	.885	23	7.21	11.00	.303	.401	59874
INT-1	1.69	7.91	.86	.511	17	2.43	12.01	.951	.041	164391
TR2S	.83	5.94	.42	.772	24	6.17	11.03	.453	.179	61698
TR3S	estimates available to ACFM in November 95									
NBTS1	.62	7.48	.30	.881	8	6.21	11.31	.372	.266	81634
NBTS2	1.42	1.36	.88	.448	9	6.23	10.19	1.156	.028	26635
						VPA Mean =	11.40	.761	.064	89322
Yearclass = 1993										
INT-0,	1.58	3.52	1.07	.386	17	3.43	8.96	1.300	.027	7785
TR1S,,	.81	5.17	.28	.885	23	6.33	10.29	.314	.465	29437
INT-1	1.69	7.91	.86	.511	17	1.62	10.64	.958	.050	41773
TR2S	estimates available to ACFM in November 95									
NBTS1	.62	7.48	.30	.881	8	6.48	11.48	.367	.340	96761
NBTS2	1.42	1.36	.88	.448	9	6.73	10.89	1.081	.039	53637
						VPA Mean =	11.40	.761	.079	89322
Yearclass = 1994										
INT-0,	1.58	3.52	1.07	.386	17	4.35	10.40	1.201	.072	32860
TR1S,,	estimates available to ACFM in November 95									
INT-1	estimates available to ACFM in November 95									
NBTS1	.62	7.48	.30	.881	8	7.84	12.32	.373	.748	224134
						VPA Mean =	11.40	.761	.180	89322
Yearclass = 1995										
INT-0,	estimates available to ACFM in November 95									

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1992	65521	11.09	.19	.17	.76		
1993	**48341**	**10.79**	**.21**	**.28**	**1.76**		
1994	165389	12.02	.32	.40	1.56		
1995	No valid surveys						

Table 3.6.11 North Sea sole Assesment summery table

Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 8	FBAR 3-10
1957	165502	88541	78903	12067	0.1529	0.1369	0.1428
1958	144952	99676	85569	14287	0.1670	0.1599	0.1806
1959	559005	116347	93191	13832	0.1484	0.1324	0.1503
1960	66859	138323	101245	18620	0.1839	0.1669	0.1794
1961	115733	156082	148954	23566	0.1582	0.1599	0.1646
1962	28345	156824	148785	26877	0.1806	0.1806	0.1932
1963	23008	150773	148402	26164	0.1763	0.2612	0.2855
1964	554351	68097	53583	11342	0.2117	0.2277	0.2439
1965	121485	122206	48952	17043	0.3482	0.2464	0.2399
1966	41180	113509	104785	33340	0.3182	0.2398	0.2226
1967	75332	109352	100873	33439	0.3315	0.3081	0.2985
1968	100099	99739	88921	33179	0.3731	0.3726	0.3425
1969	50588	83910	70372	27559	0.3916	0.4229	0.3833
1970	141485	72697	62941	19685	0.3128	0.3506	0.3206
1971	41934	72566	52376	23652	0.4516	0.4440	0.4012
1972	76952	64476	55733	21086	0.3783	0.3930	0.3681
1973	106434	56341	41866	19309	0.4612	0.4519	0.4708
1974	110794	60119	42278	17989	0.4255	0.4625	0.4850
1975	41917	59310	43020	20773	0.4829	0.4617	0.4616
1976	114190	52823	43476	17326	0.3985	0.4046	0.4316
1977	140664	56010	36043	18003	0.4995	0.3817	0.3827
1978	47105	57670	38561	20280	0.5259	0.4936	0.4786
1979	11869	53021	46183	22598	0.4893	0.4610	0.4523
1980	155027	43770	36039	15807	0.4386	0.4427	0.4452
1981	149585	51357	24743	15403	0.6225	0.4479	0.4565
1982	153581	60049	34827	21579	0.6196	0.4952	0.5041
1983	144524	68555	42228	24927	0.5903	0.4653	0.4526
1984	72084	66448	45500	26839	0.5899	0.5503	0.5410
1985	82614	55141	42750	24248	0.5672	0.5124	0.4890
1986	161774	53862	35852	18200	0.5076	0.4987	0.5934
1987	72603	57345	31227	17367	0.5561	0.4302	0.4538
1988	458688	73307	41647	21590	0.5184	0.4959	0.4617
1989	114375	97174	36257	21821	0.6018	0.3906	0.3847
1990	188146	117524	92816	35133	0.3785	0.4422	0.4636
1991	62686	107390	80872	33535	0.4147	0.4693	0.5091
1992	384086	110526	82491	29349	0.3558	0.4341	0.5002
1993	84429	106646	58058	31428	0.5413	0.5077	0.5646
1994	126347*	99561	82326	32669	0.3968	0.4982	0.5567
1995	183823**						
Arith. Mean	139219	86239	65859	22682	0.4017	0.379	0.3857
Geom.Mean	100602						
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			
period	57-92	57-94	57-94	57-94	57-94	57-94	57-94

* Replaced by 53666 estimated by RCT3

**Estimated by RCT3

Sole in the North Sea (Fishing Area IV)

Prediction with management option table: Input data

Year: 1995								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	183823.00	0.1000	0.0000	0.0000	0.0000	0.050	0.0032	0.129
2	48341.000	0.1000	0.0000	0.0000	0.0000	0.142	0.1414	0.175
3	61988.000	0.1000	1.0000	0.0000	0.0000	0.184	0.4579	0.203
4	158958.00	0.1000	1.0000	0.0000	0.0000	0.232	0.6223	0.242
5	9044.000	0.1000	1.0000	0.0000	0.0000	0.276	0.5742	0.273
6	25001.000	0.1000	1.0000	0.0000	0.0000	0.339	0.5822	0.327
7	7152.000	0.1000	1.0000	0.0000	0.0000	0.365	0.6227	0.355
8	19666.000	0.1000	1.0000	0.0000	0.0000	0.448	0.4868	0.444
9	608.000	0.1000	1.0000	0.0000	0.0000	0.469	0.5896	0.463
10	1200.000	0.1000	1.0000	0.0000	0.0000	0.473	0.5521	0.521
11	380.000	0.1000	1.0000	0.0000	0.0000	0.493	0.5117	0.556
12	112.000	0.1000	1.0000	0.0000	0.0000	0.489	0.6732	0.513
13	201.000	0.1000	1.0000	0.0000	0.0000	0.578	0.6019	0.639
14	78.000	0.1000	1.0000	0.0000	0.0000	0.645	0.6542	0.663
15+	296.000	0.1000	1.0000	0.0000	0.0000	0.598	0.6542	0.613
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1996								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	100602.00	0.1000	0.0000	0.0000	0.0000	0.050	0.0032	0.129
2	.	0.1000	0.0000	0.0000	0.0000	0.142	0.1414	0.175
3	.	0.1000	1.0000	0.0000	0.0000	0.184	0.4579	0.203
4	.	0.1000	1.0000	0.0000	0.0000	0.232	0.6223	.42
5	.	0.1000	1.0000	0.0000	0.0000	0.276	0.5742	0.273
6	.	0.1000	1.0000	0.0000	0.0000	0.339	0.5822	0.327
7	.	0.1000	1.0000	0.0000	0.0000	0.365	0.6227	0.355
8	.	0.1000	1.0000	0.0000	0.0000	0.448	0.4868	0.444
9	.	0.1000	1.0000	0.0000	0.0000	0.469	0.5896	0.463
10	.	0.1000	1.0000	0.0000	0.0000	0.473	0.5521	0.521
11	.	0.1000	1.0000	0.0000	0.0000	0.493	0.5117	0.556
12	.	0.1000	1.0000	0.0000	0.0000	0.489	0.6732	0.513
13	.	0.1000	1.0000	0.0000	0.0000	0.578	0.6019	0.639
14	.	0.1000	1.0000	0.0000	0.0000	0.645	0.6542	0.663
15+	.	0.1000	1.0000	0.0000	0.0000	0.598	0.6542	0.613
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Year: 1997								
Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	100602.00	0.1000	0.0000	0.0000	0.0000	0.050	0.0032	0.129
2	.	0.1000	0.0000	0.0000	0.0000	0.142	0.1414	0.175
3	.	0.1000	1.0000	0.0000	0.0000	0.184	0.4579	0.203
4	.	0.1000	1.0000	0.0000	0.0000	0.232	0.6223	0.242
5	.	0.1000	1.0000	0.0000	0.0000	0.276	0.5742	0.273
6	.	0.1000	1.0000	0.0000	0.0000	0.339	0.5822	0.327
7	.	0.1000	1.0000	0.0000	0.0000	0.365	0.6227	0.355
8	.	0.1000	1.0000	0.0000	0.0000	0.448	0.4868	0.444
9	.	0.1000	1.0000	0.0000	0.0000	0.469	0.5896	0.463
10	.	0.1000	1.0000	0.0000	0.0000	0.473	0.5521	0.521
11	.	0.1000	1.0000	0.0000	0.0000	0.493	0.5117	0.556
12	.	0.1000	1.0000	0.0000	0.0000	0.489	0.6732	0.513
13	.	0.1000	1.0000	0.0000	0.0000	0.578	0.6019	0.639
14	.	0.1000	1.0000	0.0000	0.0000	0.645	0.6542	0.663
15+	.	0.1000	1.0000	0.0000	0.0000	0.598	0.6542	0.613
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : S4PRED3
Date and time: 04OCT95:18:55

Table 3.6.13

18:53 Wednesday, October 4,

Sole in the North Sea (Fishing Area IV)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	3961.620	8.603	3782.862	8.603	3782.862
0.1000	0.0498	0.308	121.404	7.436	2301.382	5.531	2122.665	5.531	2122.665
0.2000	0.0996	0.447	157.243	6.046	1608.473	4.141	1429.797	4.141	1429.797
0.3000	0.1495	0.528	169.387	5.242	1237.643	3.338	1059.008	3.338	1059.008
0.4000	0.1993	0.581	173.218	4.715	1011.193	2.811	832.599	2.811	832.599
0.5000	0.2491	0.618	173.833	4.342	860.840	2.438	682.287	2.438	682.287
0.6000	0.2989	0.647	173.179	4.063	754.963	2.160	576.452	2.160	576.452
0.7000	0.3488	0.669	172.060	3.848	677.040	1.945	498.570	1.945	498.570
0.8000	0.3986	0.686	170.822	3.675	617.664	1.773	439.235	1.773	439.235
0.9000	0.4484	0.701	169.611	3.534	571.126	1.632	392.738	1.632	392.738
1.0000	0.4982	0.713	168.484	3.416	533.786	1.515	355.439	1.515	355.439
1.1000	0.5480	0.723	167.460	3.317	503.223	1.415	324.917	1.415	324.917
1.2000	0.5979	0.732	166.539	3.231	477.779	1.329	299.514	1.329	299.514
1.3000	0.6477	0.739	165.713	3.156	456.280	1.255	278.056	1.255	278.056
1.4000	0.6975	0.746	164.972	3.090	437.877	1.190	259.694	1.190	259.694
1.5000	0.7473	0.752	164.308	3.032	421.945	1.132	243.803	1.132	243.803
1.6000	0.7971	0.758	163.708	2.980	408.011	1.080	229.910	1.080	229.910
1.7000	0.8470	0.763	163.166	2.933	395.714	1.033	217.654	1.033	217.654
1.8000	0.8968	0.767	162.674	2.890	384.774	0.990	206.756	0.990	206.756
1.9000	0.9466	0.771	162.225	2.851	374.972	0.952	196.994	0.952	196.994
2.0000	0.9964	0.775	161.814	2.815	366.129	0.916	188.193	0.916	188.193
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : S4YR2
Date and time : 040CT95:19:05
Computation of ref. F: Simple mean, age 2 - 8
F-0.1 factor : 0.1869
F-max factor : 0.4833
F-0.1 reference F : 0.0931
F-max reference F : 0.2408
Recruitment : Single recruit

Table 3.6.14

18:53 Wednesday, October 4, 1995

Sole in the North Sea (Fishing Area IV)

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4982	88122	72051	32074	0.0000	0.0000	78716	50093	0	99553	81570
.	.	.	.	.	0.1000	0.0498	.	50093	3063	96177	78197
.	.	.	.	.	0.2000	0.0996	.	50093	5974	92972	74997
.	.	.	.	.	0.3000	0.1495	.	50093	8742	89930	71959
.	.	.	.	.	0.4000	0.1993	.	50093	11374	87041	69074
.	.	.	.	.	0.5000	0.2491	.	50093	13878	84297	66334
.	.	.	.	.	0.6000	0.2989	.	50093	16261	81691	63732
.	.	.	.	.	0.7000	0.3488	.	50093	18528	79214	61260
.	.	.	.	.	0.8000	0.3986	.	50093	20687	76860	58910
.	.	.	.	.	0.9000	0.4484	.	50093	22743	74622	56676
.	.	.	.	.	1.0000	0.4982	.	50093	24701	72494	54552
.	.	.	.	.	1.1000	0.5480	.	50093	26567	70469	52531
.	.	.	.	.	1.2000	0.5979	.	50093	28346	68543	50609
.	.	.	.	.	1.3000	0.6477	.	50093	30043	66710	48780
.	.	.	.	.	1.4000	0.6975	.	50093	31661	64964	47039
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : S4PRED3
Date and time : 04OCT95:18:55
Computation of ref. F: Simple mean, age 2 - 8
Basis for 1995 : F factors

Sole in the North Sea (Fishing Area IV)

Single option prediction: Detailed tables

Year: 1995 F-factor: 1.0000 Reference F: 0.4982

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0032	559	72	183823	9191	0	0	0	0
2	0.1414	6073	1063	48341	6879	0	0	0	0
3	0.4579	21755	4423	61988	11387	61988	11387	61988	11387
4	0.6223	70443	17047	158958	36831	158958	36831	158958	36831
5	0.5742	3778	1032	9044	2493	9044	2493	9044	2493
6	0.5822	10551	3450	25001	8483	25001	8483	25001	8483
7	0.6227	3171	1126	7152	2608	7152	2608	7152	2608
8	0.4868	7242	3218	19666	8810	19666	8810	19666	8810
9	0.5896	259	120	608	285	608	285	608	285
10	0.5521	487	253	1200	568	1200	568	1200	568
11	0.5117	145	81	380	187	380	187	380	187
12	0.6732	53	27	112	55	112	55	112	55
13	0.6019	87	56	201	116	201	116	201	116
14	0.6542	36	24	78	50	78	50	78	50
15+	0.6542	136	83	296	177	296	177	296	177
Total		124773	32074	516848	88122	284684	72051	284684	72051
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Year: 1996 F-factor: 1.0000 Reference F: 0.4982

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0032	306	39	100602	5030	0	0	0	0
2	0.1414	20829	3645	165799	23593	0	0	0	0
3	0.4579	13327	2709	37973	6976	37973	6976	37973	6976
4	0.6223	15724	3805	35483	8221	35483	8221	35483	8221
5	0.5742	32244	8812	77195	21283	77195	21283	77195	21283
6	0.5822	1945	636	4608	1564	4608	1564	4608	1564
7	0.6227	5603	1989	12638	4609	12638	4609	12638	4609
8	0.4868	1279	568	3472	1555	3472	1555	3472	1555
9	0.5896	4659	2156	10936	5132	10936	5132	10936	5132
10	0.5521	124	64	305	144	305	144	305	144
11	0.5117	239	133	625	308	625	308	625	308
12	0.6732	97	50	206	101	206	101	206	101
13	0.6019	22	14	52	30	52	30	52	30
14	0.6542	46	30	100	64	100	64	100	64
15+	0.6542	81	50	176	105	176	105	176	105
Total		96523	24701	450170	78716	183770	50093	183770	50093
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

(cont.)

Table 3.6.15Continued

18:53 Wednesday, October 4,

Sole in the North Sea (Fishing Area IV)

Single option prediction: Detailed tables

(cont.)

Year: 1997 F-factor: 1.0000 Reference F: 0.4982

						1 January		Spawning time	
Age	Absolute F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
1	0.0032	306	39	100602	5030	0	0	0	0
2	0.1414	11399	1995	90738	12912	0	0	0	0
3	0.4579	45707	9292	130239	23925	130239	23925	130239	23925
4	0.6223	9632	2331	21736	5036	21736	5036	21736	5036
5	0.5742	7197	1967	17232	4751	17232	4751	17232	4751
6	0.5822	16600	5428	39336	13347	39336	13347	39336	13347
7	0.6227	1033	367	2330	850	2330	850	2330	850
8	0.4868	2259	1004	6135	2748	6135	2748	6135	2748
9	0.5896	822	381	1931	906	1931	906	1931	906
10	0.5521	2226	1159	5488	2596	5488	2596	5488	2596
11	0.5117	61	34	159	78	159	78	159	78
12	0.6732	159	82	339	166	339	166	339	166
13	0.6019	41	26	95	55	95	55	95	55
14	0.6542	12	8	26	17	26	17	26	17
15+	0.6542	60	36	130	78	130	78	130	78
Total		97515	24149	416514	72494	225174	54552	225174	54552
Unit	-	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes	Thousands	Tonnes

Notes: Run name : S4PRED4
Date and time : 04OCT95:19:00
Computation of ref. F: Simple mean, age 2 - 8
Prediction basis : F factors

Table 3.6.16 North Sea Sole (IV) Input data for linear sensetivity analysis

Name	Value	certainty (CV)	Name	Value	certainty (CV)
Population at age in 1995			Fishing mortality pattern		
N1	183823	0.40	sH1	0.003	0.64
N2	48341	0.28	sH2	0.141	0.23
N3	61988	0.17	sH3	0.458	0.08
N4	158958	0.13	sH4	0.622	0.28
N5	9044	0.14	sH5	0.574	0.17
N6	25001	0.12	sH6	0.582	0.2
N7	7152	0.13	sH7	0.623	0.23
N8	19666	0.12	sH8	0.487	0.15
N9	608	0.16	sH9	0.59	0.21
N10	1200	0.15	sH10	0.552	0.25
N11	380	0.17	sH11	0.512	0.18
N12	112	0.23	sH12	0.673	0.3
N13	201	0.24	sH13	0.602	0.16
N14	78	0.26	sH14	0.654	0.11
N15	296	0.29	sH15	0.654	0.11
Weight in the catch at age			Weight in the stock at age		
WH1	0.129	0.21	WS1	0.05	0
WH2	0.175	0.04	WS2	0.142	0.1
WH3	0.203	0.04	WS3	0.184	0.06
WH4	0.242	0.06	WS4	0.232	0.11
WH5	0.273	0.08	WS5	0.276	0.1
WH6	0.327	0.14	WS6	0.339	0.16
WH7	0.355	0.14	WS7	0.365	0.1
WH8	0.444	0.03	WS8	0.448	0.09
WH9	0.463	0.1	WS9	0.469	0.09
WH10	0.521	0.2	WS10	0.473	0.24
WH11	0.556	0.07	WS11	0.493	0.13
WH12	0.513	0.13	WS12	0.489	0.08
WH13	0.639	0.05	WS13	0.578	0.17
WH14	0.663	0.15	WS14	0.645	0.1
WH15	0.613	0.08	WS15	0.598	0.14
Natural mortality pattern			Maturity ogive pattern		
M1	0.1	0.1	MT1	0	0
M2	0.1	0.1	MT2	0	0.1
M3	0.1	0.1	MT3	1	0.1
M4	0.1	0.1	MT4	1	0
M5	0.1	0.1	MT5	1	0
M6	0.1	0.1	MT6	1	0
M7	0.1	0.1	MT7	1	0
M8	0.1	0.1	MT8	1	0
M9	0.1	0.1	MT9	1	0
M10	0.1	0.1	MT10	1	0
M11	0.1	0.1	MT11	1	0
M12	0.1	0.1	MT12	1	0
M13	0.1	0.1	MT13	1	0
M14	0.1	0.1	MT14	1	0
M15	0.1	0.1	MT15	1	0
Effort multiplier in year			Natural mortality multiplier in year		
HF95	1	0.07	K95	1	0.1
HF96	1	0.07	K96	1	0.1
HF97	1	0.07	K97	1	0.1
Recruitment in year					
R96	100602	0.81			
R97	100602	0.81			

Table 3.6.17 Stock: North Sea sole

Assessment Quality Control Diagram 1

Average F(2-8,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	0.51	0.55						
1990	0.48	0.58	0.53					
1991	0.45	0.52	0.42	0.55				
1992	0.41	0.46	0.36	0.40	0.47			
1993	0.43	0.49	0.38	0.43	0.52	0.50		
1994	0.43	0.50	0.39	0.43	0.45	0.41	0.46	
1995	0.43	0.50	0.39	0.44	0.47	0.43	0.51	0.50

Remarks:

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: millions								
Date of assessment	Year class							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	101[1]	52[1]						
1990	106[1]	99[1]	15[1]					
1991	117[1]	125[1]	70[1]	137[1]				
1992	105	147[1]	51[1]	275[1]	55[1]			
1993	101	137	49[1]	275[1]	56[1]	97[2]		
1994	122	185	55	326	71[1]	86[1]	97[2]	
1995	114	188	63	384	84	54[1]	184[1]	101[2]

[1]Predicted from surveys. [2]GM.

Remarks:

Table 3.6.17 Continued Stock: North Sea sole

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	32.2	27.1	n/a[1]	n/a[1]						
1990	37.8	29.8	69.9	58.0[1]	46.0[1]					
1991	40.5	34.1	67.6	56.0	47.0[1]	37.0[1]				
1992	42.9	38.2	94.2	80.2	73.7	54.4[1]	69.8[1]			
1993	41.9	37.2	92.7	78.3	66.2	50.1	65.9[1]	51.2[1]		
1994	41.6	36.4	95.7	85.3	87.1	60.8	85.3	67.5[1]	72.2[1]	
1995	41.6	36.3	92.8	80.3	82.5	58.1	82.3	72.1	50.1[1]	54.6[1]

[1]Forecast.

Remarks:

Table 3.6.18 North Sea sole Indices of effort and CPUE

	Effort						CPUE					
	1 Belgium	2 UK-ot	3 UK-bt	4 Netherlands	5 France-bt	6 Denmark	7 Belgium	8 UK-ot	9 UK-bt	10 Netherlands	11 France-bt	12 Denmark
1971												
1972	29.8						33.5					
1973	29.4						33.1					
1974	32.2						23.7					
1975	39.2						26.2					
1976	44.7						24.5					
1977	47.6						27.2					
1978	50.3			44.3			25.9			375.8		
1979	40.0			44.9			38.7			423.2		
1980	35.2	166.8	36.5	45.0			30.9	2.71	12.39	282.1		
1981	31.1	160.1	35.7	46.3			35.2	2.38	10.68	267.8		
1982	34.9	156.9	35.3	57.3			44.7	2.57	11.44	309.8		
1983	35.4	160.1	24.4	65.6		3301	42.8	2.7	17.71	319.9		133
1984	42.8	146.7	34.6	70.8		1203	35.2	3.84	16.27	307.7		301
1985	51.4	170.5	65.5	70.3	12791	488	40.8	4.79	12.46	276.3	25.0	821
1986	42.5	243.6	49.2	68.2	9665	1425	38.8	2.66	13.16	213.7	18.5	174
1987	50.7	257.4	78.3	68.5	8162	1515	28.9	2.63	8.65	204.8	18.0	161
1988	53.0	250.9	87.3	76.3	9150	2539	19.2	2.95	8.48	235.9	15.4	206
1989	54.3	263.9	123.2	61.6	10485	2001	22.7	3.8	8.14	272.7	11.4	207
1990	64.7	819.4	180.4	71.4	11787	2011	24.8	2.16	9.81	379.2	12.4	759
1991	74.3	577.7	210.9	68.5	12116	2712	33.5	2.87	7.86	349.9	16.4	791
1992	67.7	644.7	195.7	71.1	10939	n.a	22,5*	1.94	6.38	307.1	14.6	n.a.
1993	71.1	532.1	166.6	76.8	n.a.	n.a.	27,2*	2.12	6.77	306.4	n.a.	n.a.
1994	60.0	557.1	155.2	81.1	n.a.	n.a.	32,5*	1.97	7.08	296.7	n.a.	n.a.

1	fishing hours in 1000 HP beam trawl units * 10E3	measured
2	otter trawl units * 10E2 (areas 3 + 4)	derived
3	beam trawl units * 10E2 (areas 3 + 4)	derived
4	million HP days beam trawl	measured
5	hours beam trawl	measured
6	fishing days gill net 2nd quarter	measured
7	Kg/FH 1000 HP beam trawl	derived
8	otter trawl kg/FH (areas 3 + 4)	measured
9	beam trawl kg/FH (areas 3 + 4)	measured
10	kg/1000 HP day	derived
11	kg/hour	derived
12	kg/fishing day, 2nd quarter	derived

* biased by national indiviual restrictions in landings per day and per HP

E:\ACFM\wgnssk96\sol_nsea\t3618.xls

Figure 3.6.1 North Sea sole Historical trends in the stock

E:\acfm\wgnssk96\sol_nsea\fig361.xls

Figure 3.6.2 **North Sea sole - retrospective analysis - Taper influence**

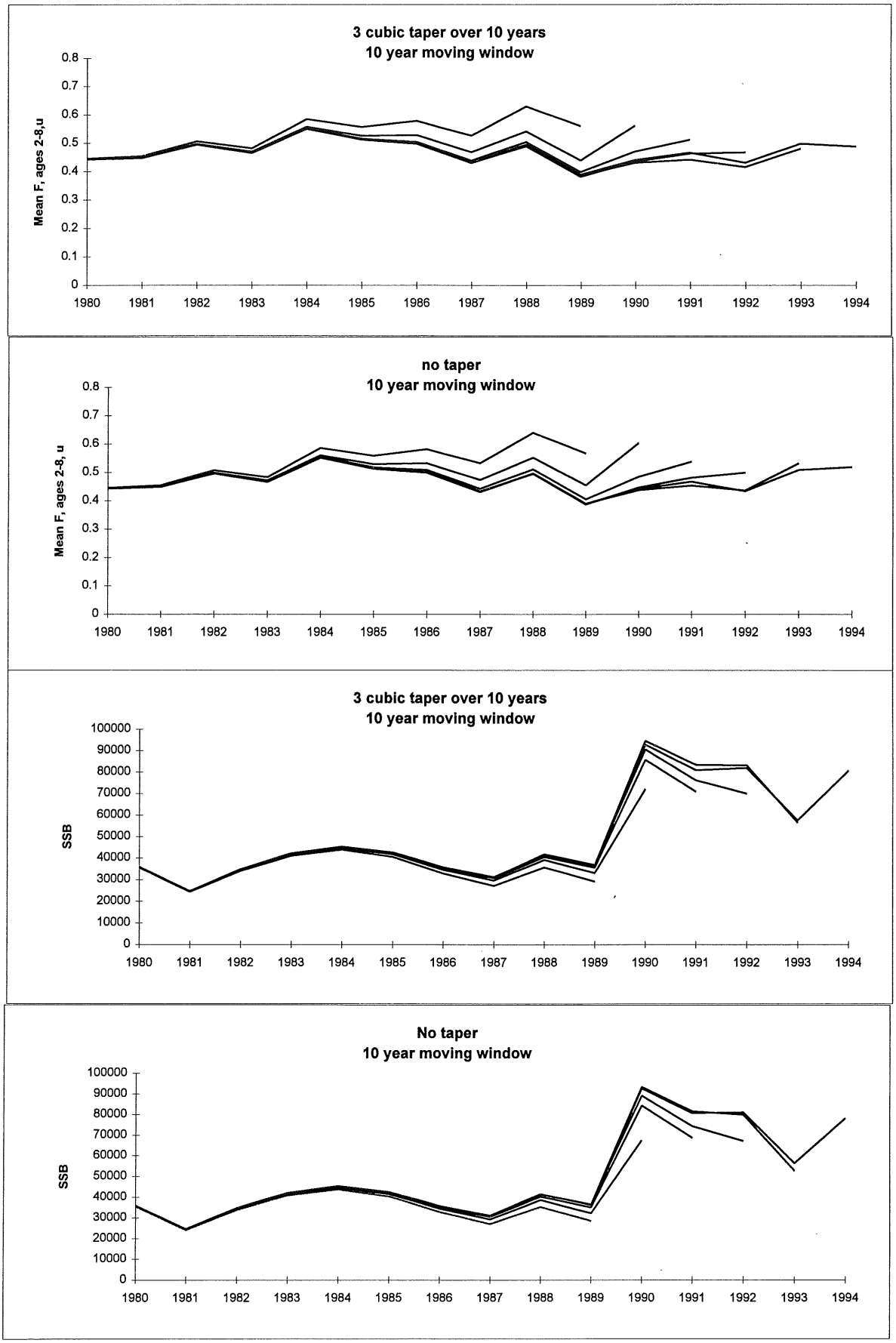
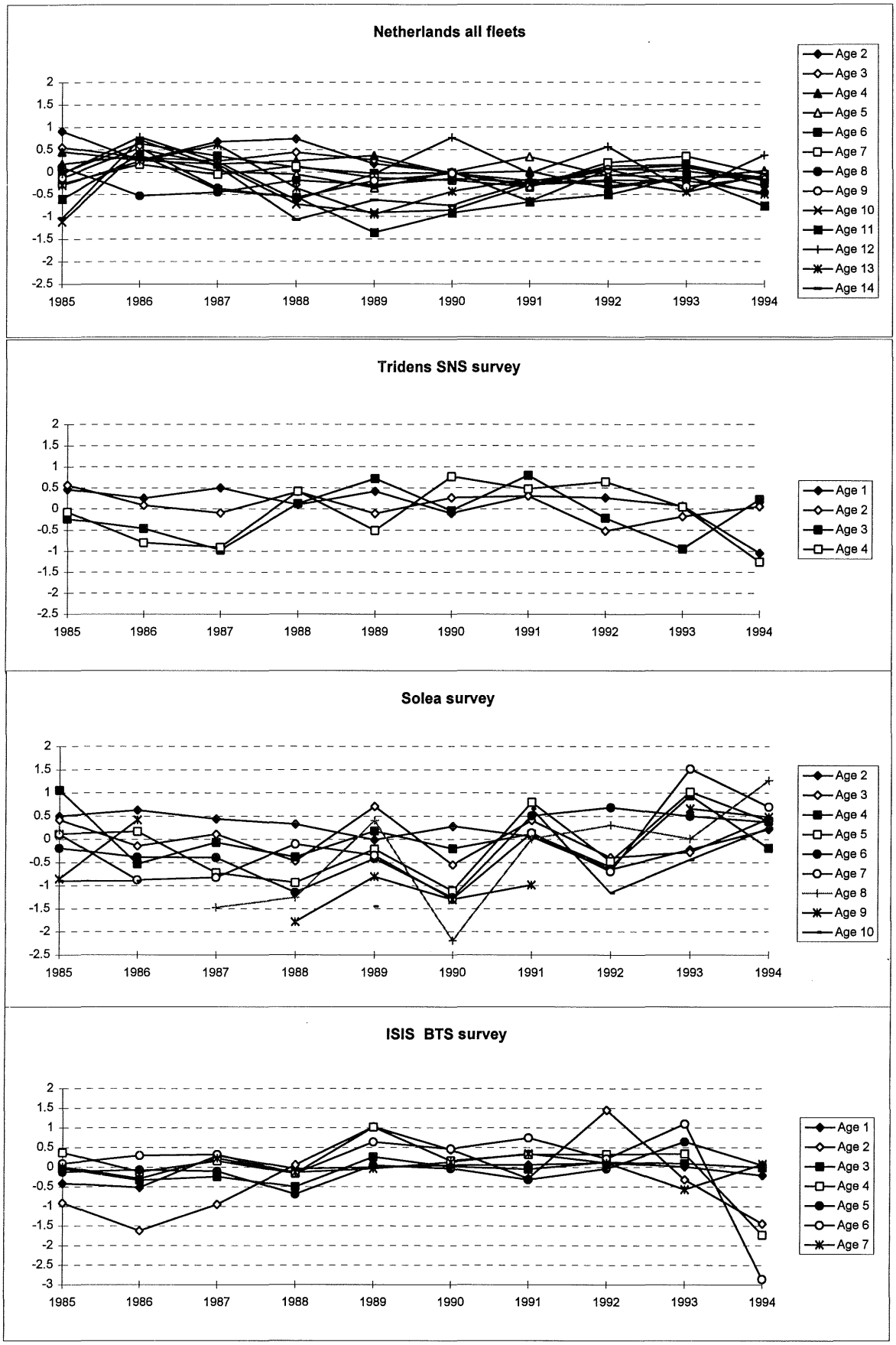
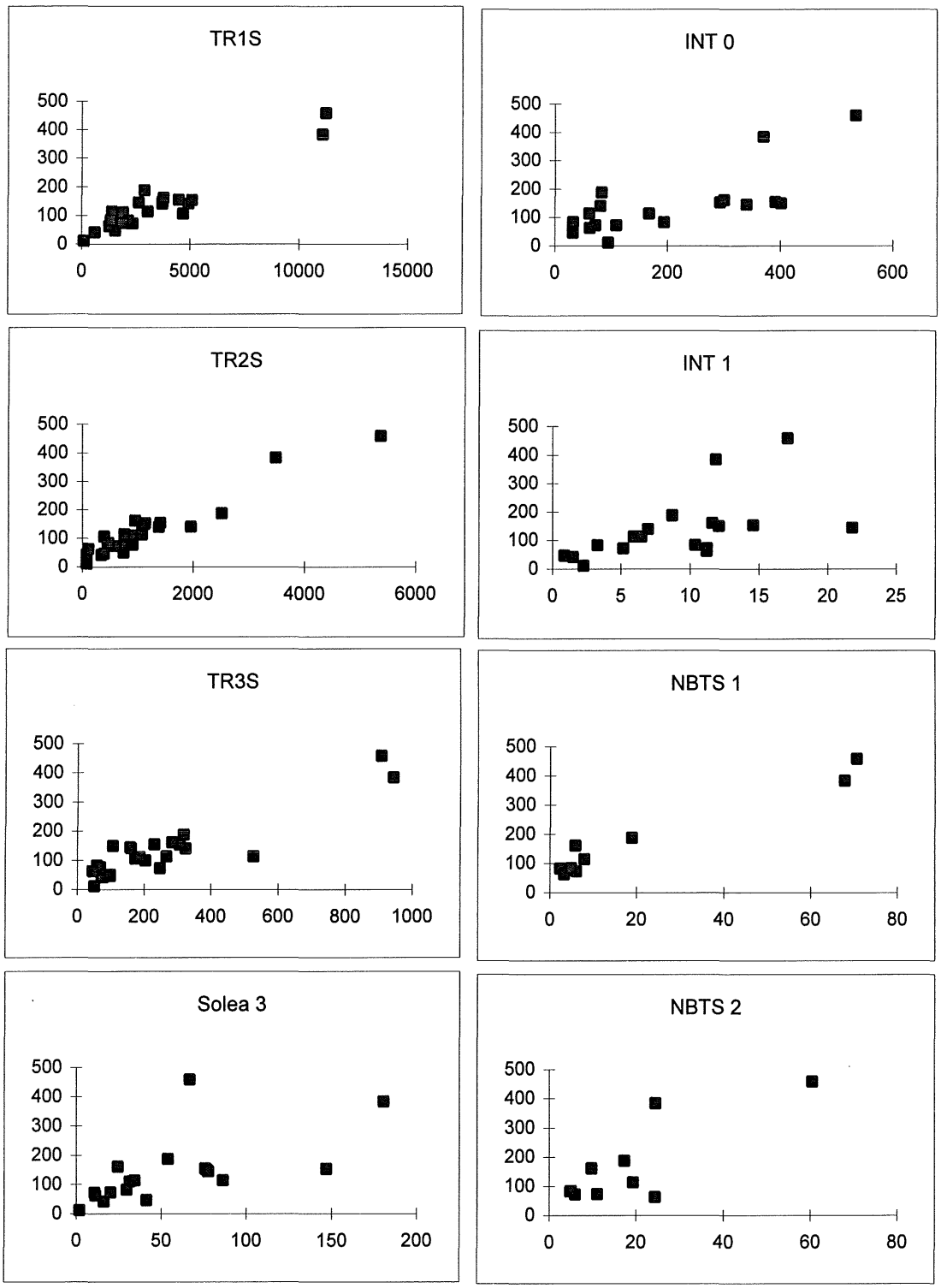


Figure 3.6.3 North Sea sole Log catchability residual plot (XSA)



E:\acfm\wgnssk96\sol_nsea\fig363.xls

Figure 3.6.4 North Sea Sole - indices of recruitment against VPA



E:\acfm\wgnssk96\sol_nsea\fig364.xls

Figure 3.6.4 North Sea Sole - indices of recruitment against VPA

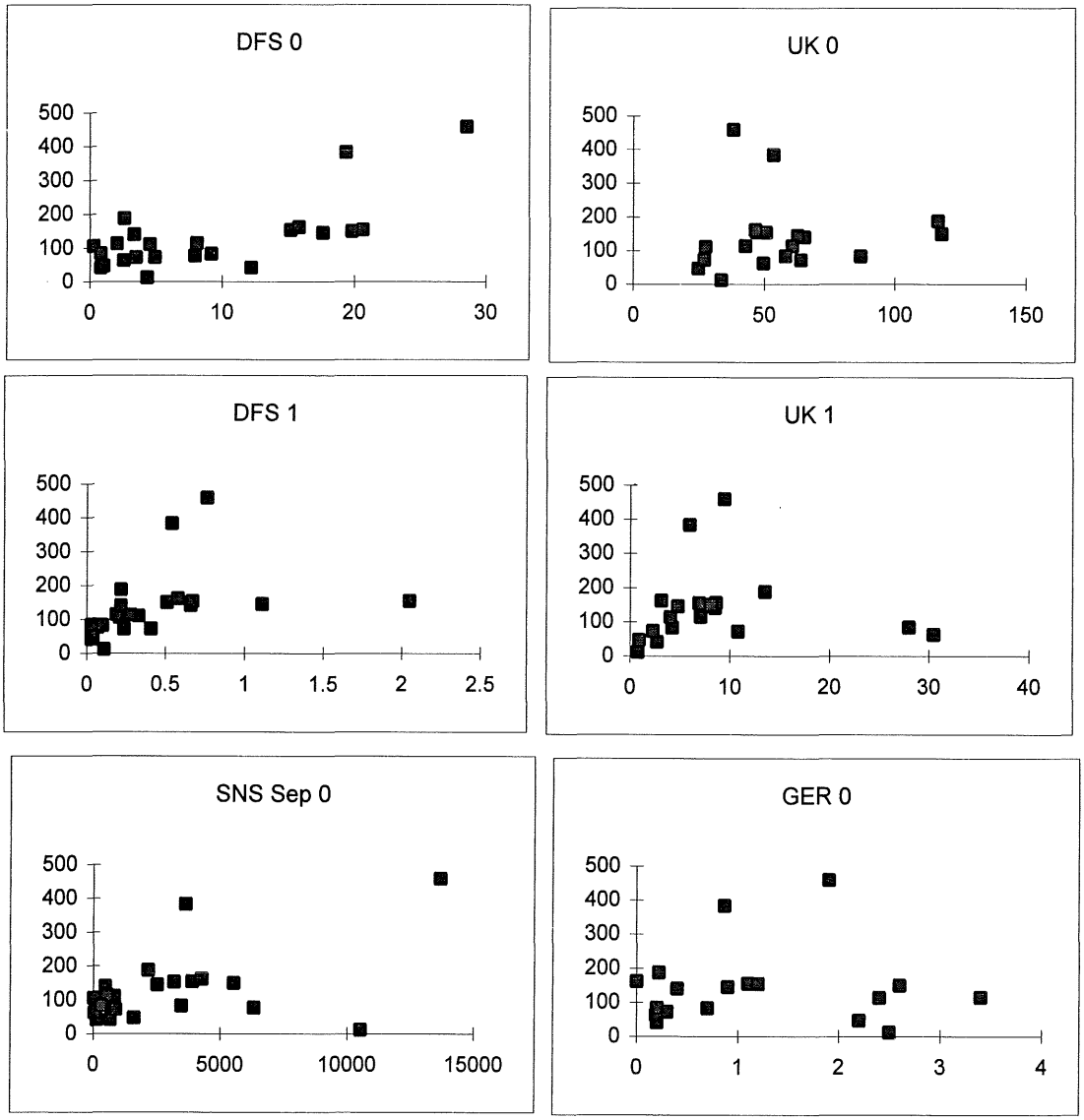
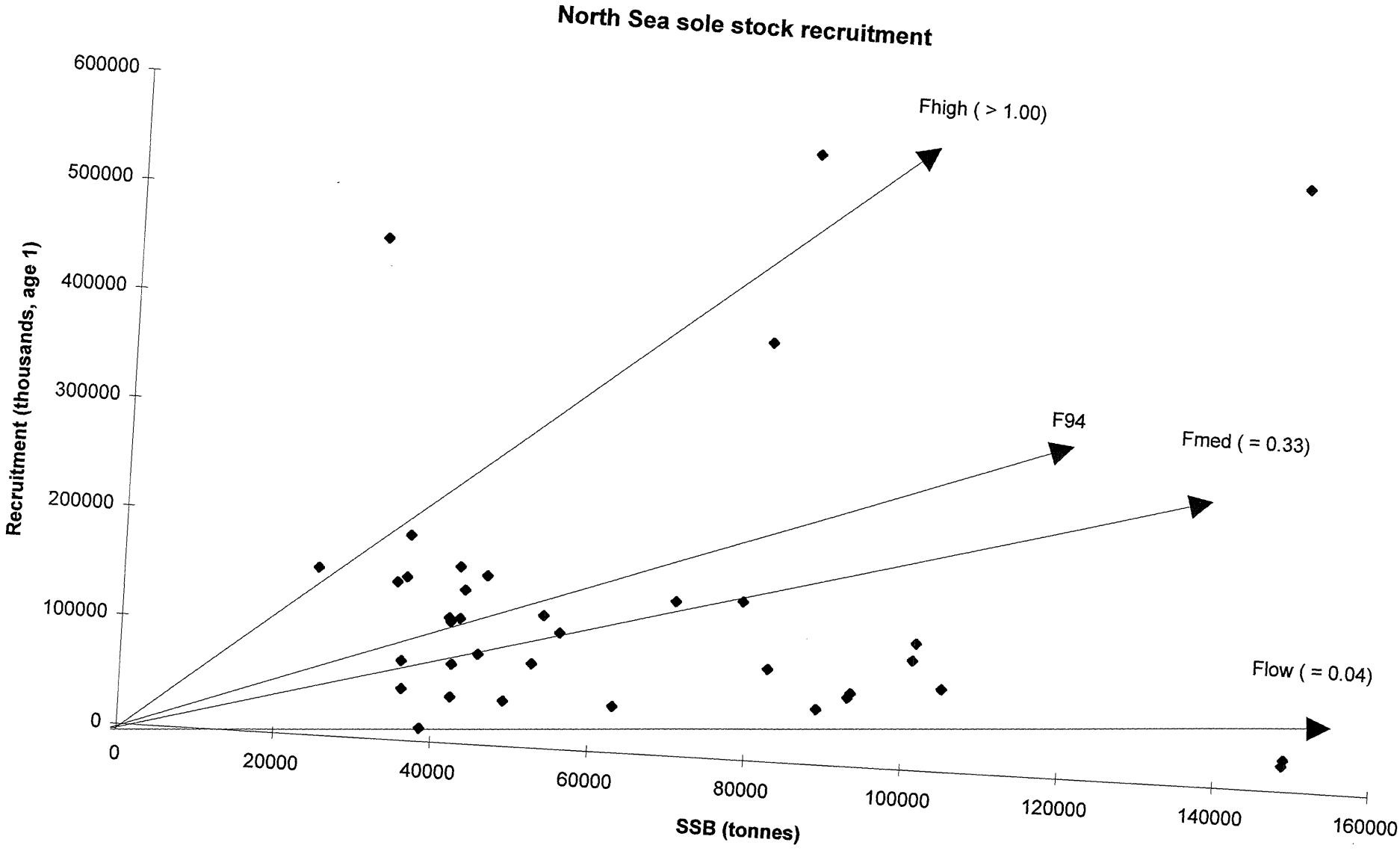


Figure 3.6.5

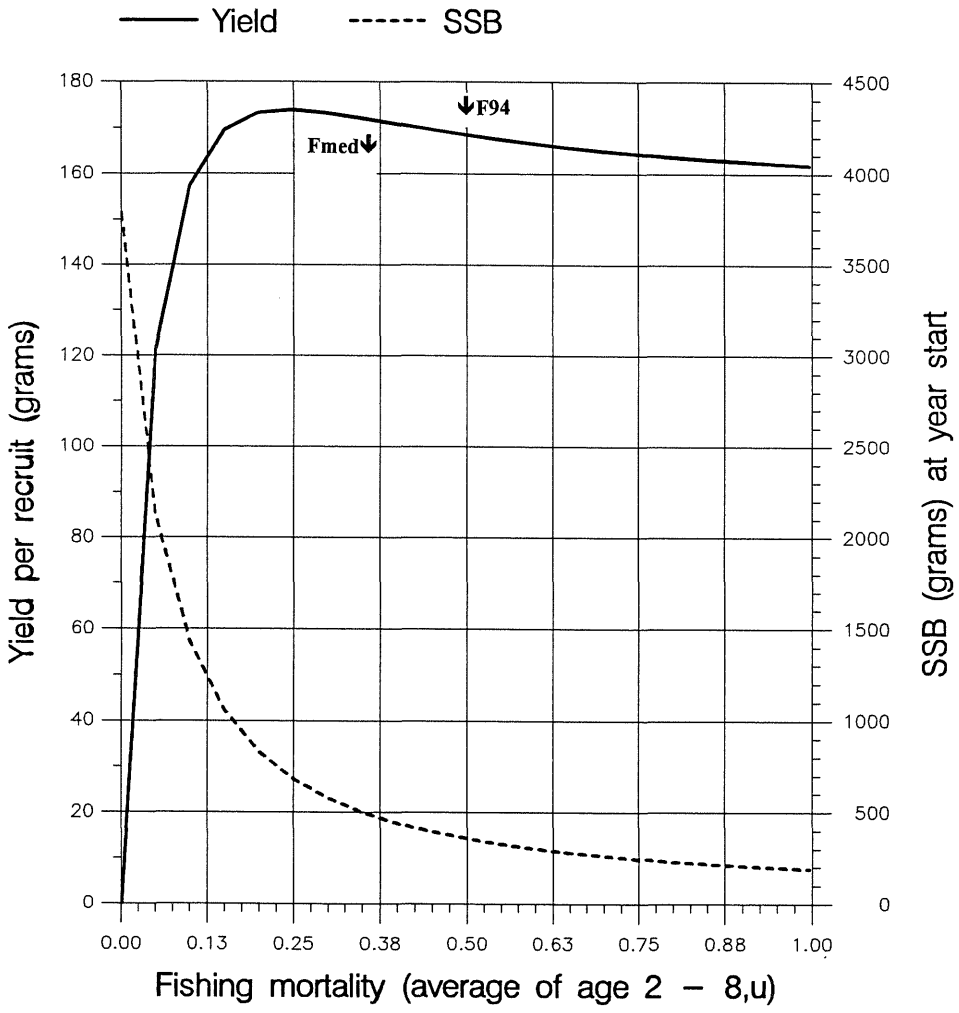


E:\acfm\wgnssk96\sol_nsea\fig365.xls

Figure 3.6.6

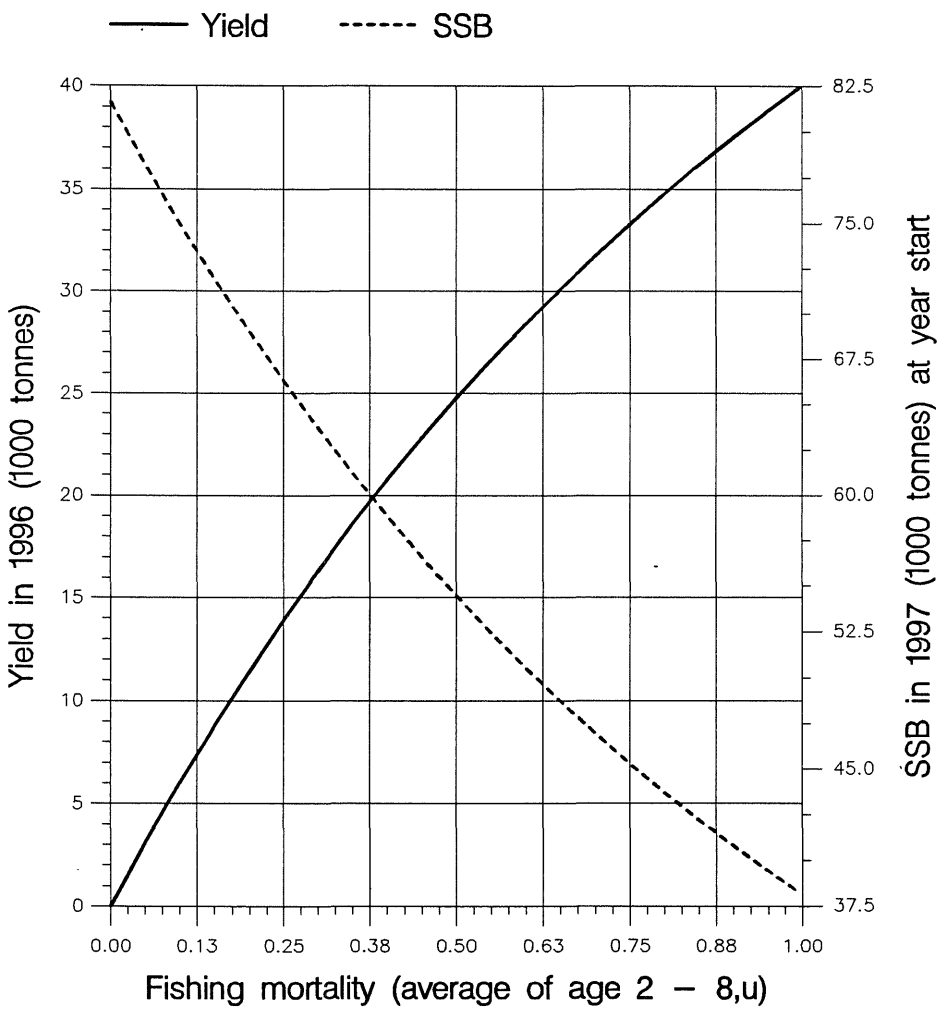
Fish Stock Summary
Sole in the North Sea (Fishing Area IV)
4–10–1995

Long term yield and spawning stock biomass



(run: S4YR2) C

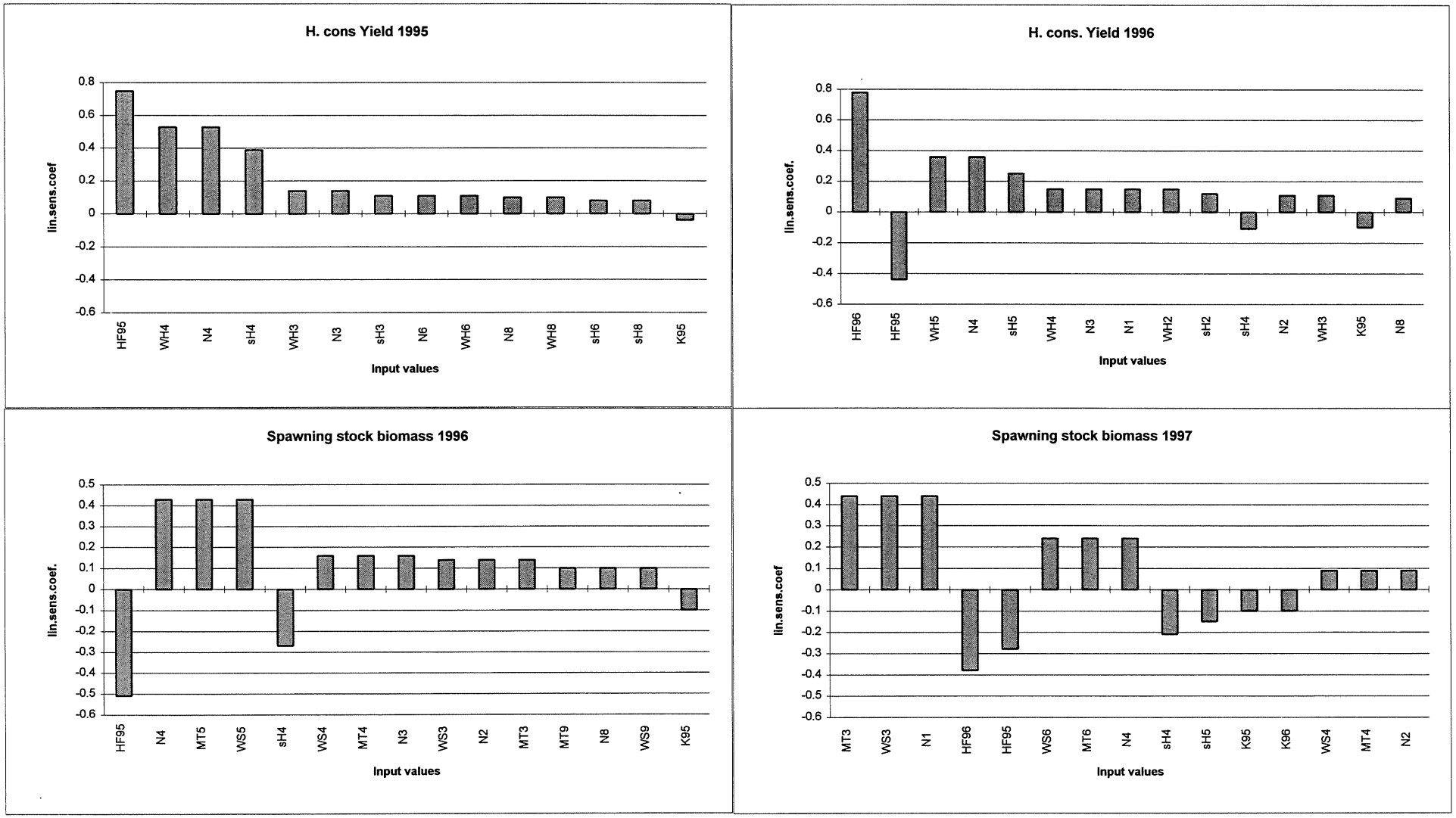
Short term yield and spawning stock biomass



(run: S4PRED3) D

Figure 3.6.7 **North Sea Sole. Sensitivity analyses of short term forecast**

Linear sensitivity coefficients



E:\acfm\wgnssk96\sol_nsea\fig367.xls

Figure 3.6.8 **North Sea Sole. Sensitivity analyses of short term forecast**

Proportion of total variance contributed by each input value

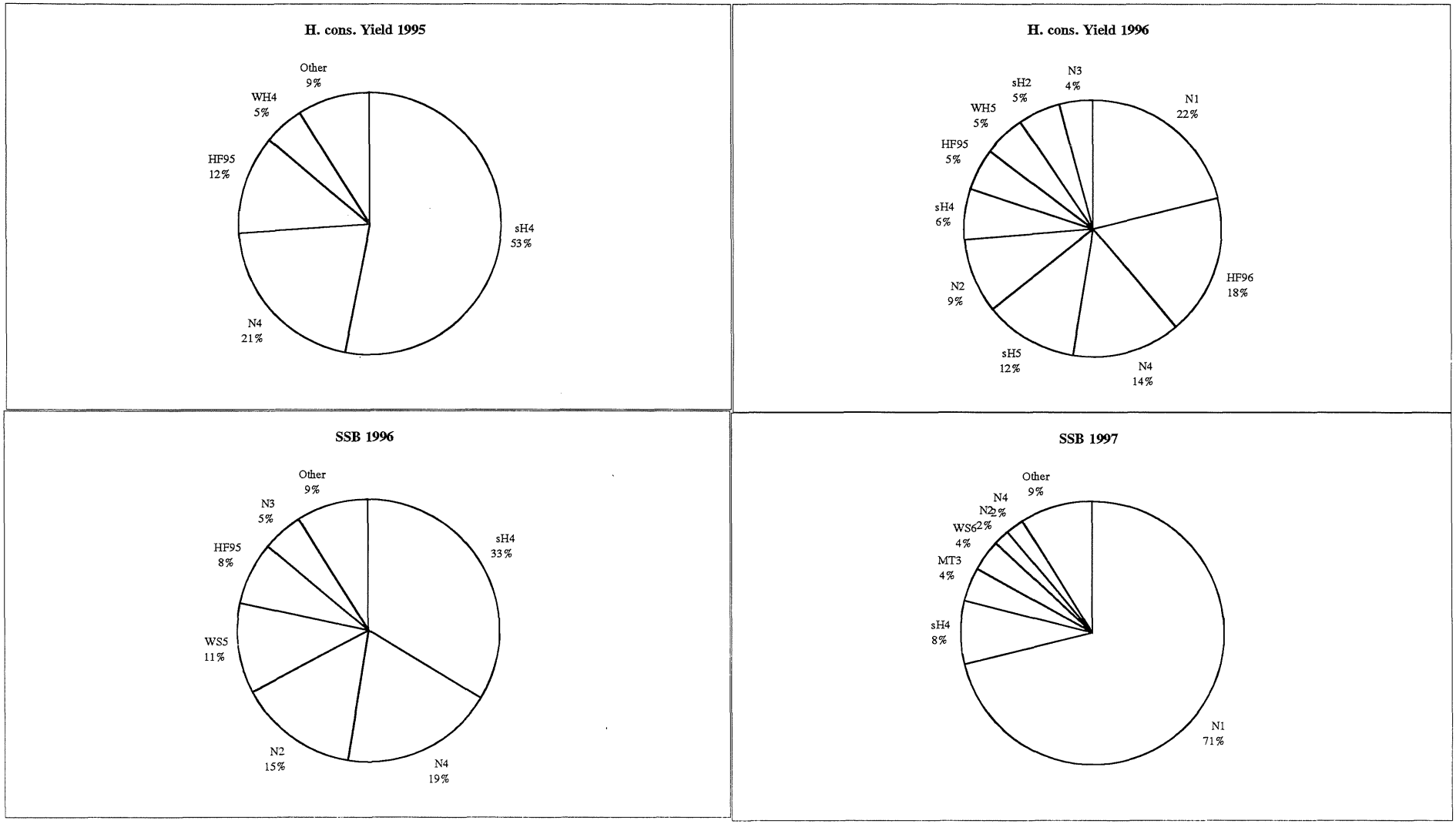


Figure 3.6.9 North Sea Sole. Sensitivity analyses of short term forecast

Cumlative probability distributions

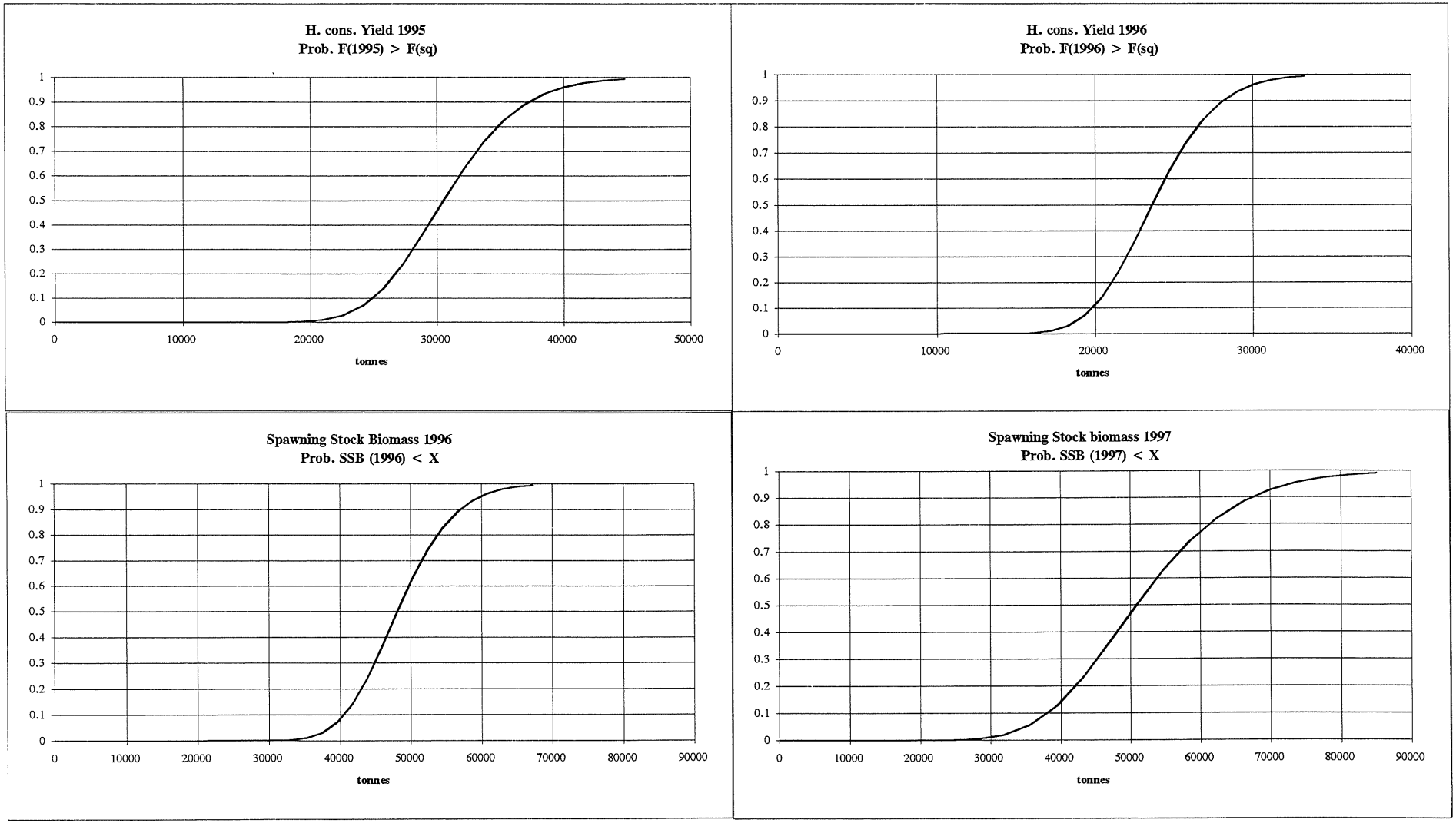
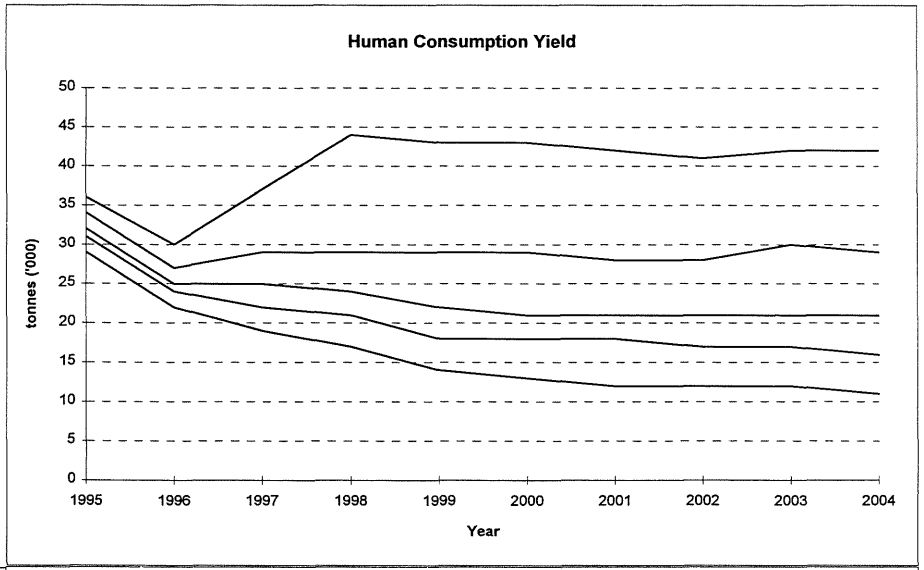
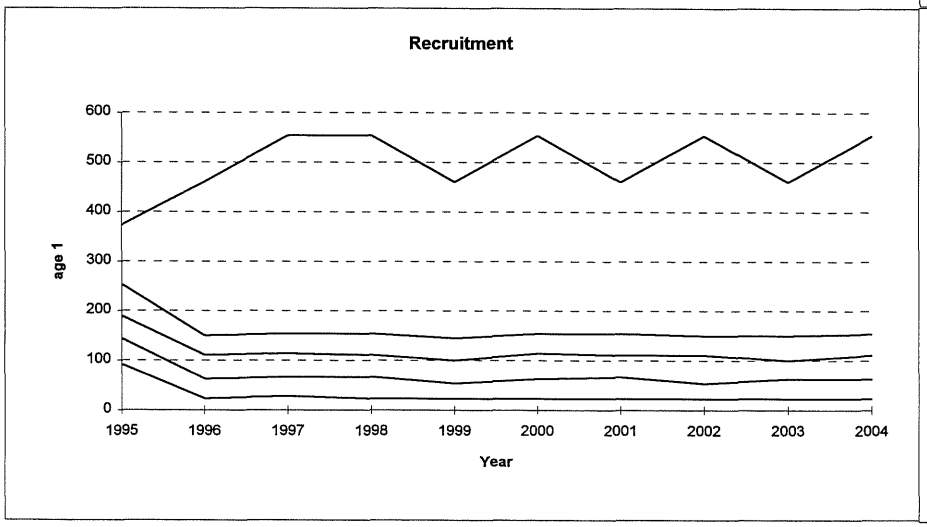
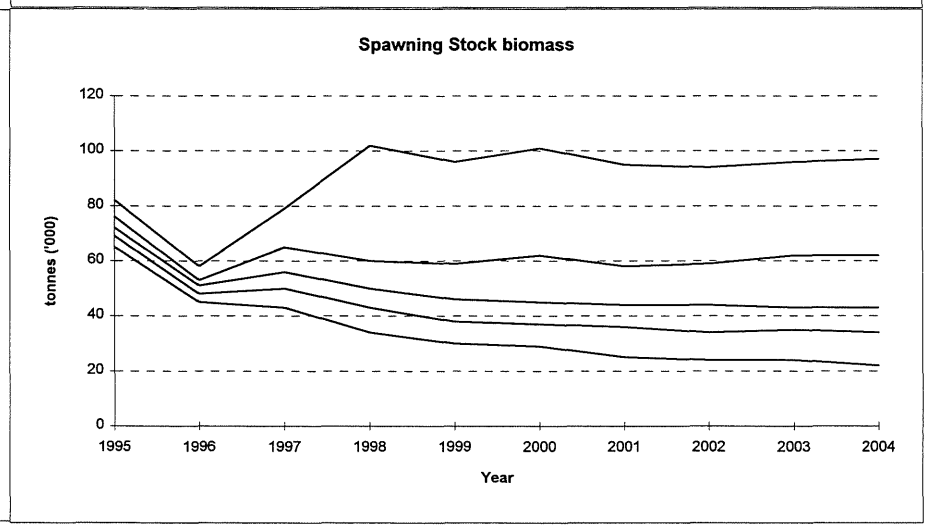


Figure 3.6.10 **North Sea Sole. Medium term projections. Solid lines show 5, 25, 50 and 95 percentiles**
no stock-recruitment relationship
number of simulations 500

Relative Cons. effort = 1.00



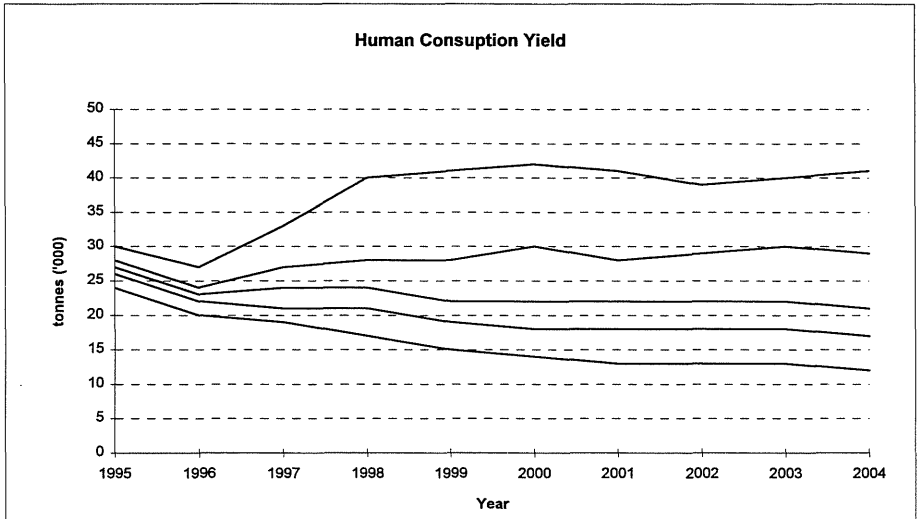


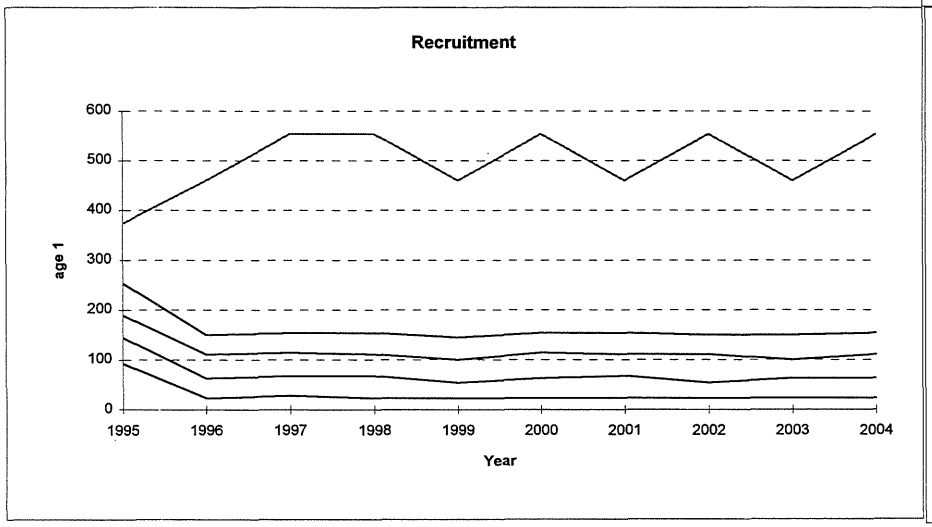


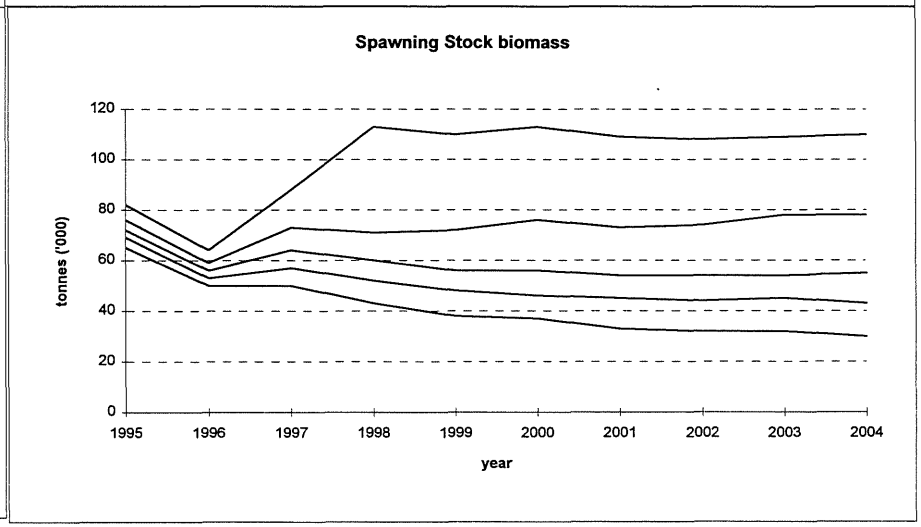
E:\acfm\wgnssk96\n_sol\fig3610.xls

Figure 3.6.11 **North Sea Sole. Medium term projections. Solid lines show 5, 25, 50 and 95 percentiles**
no stock-recruitment relationship
number of simulations 500

Relative Cons. effort = 0.80



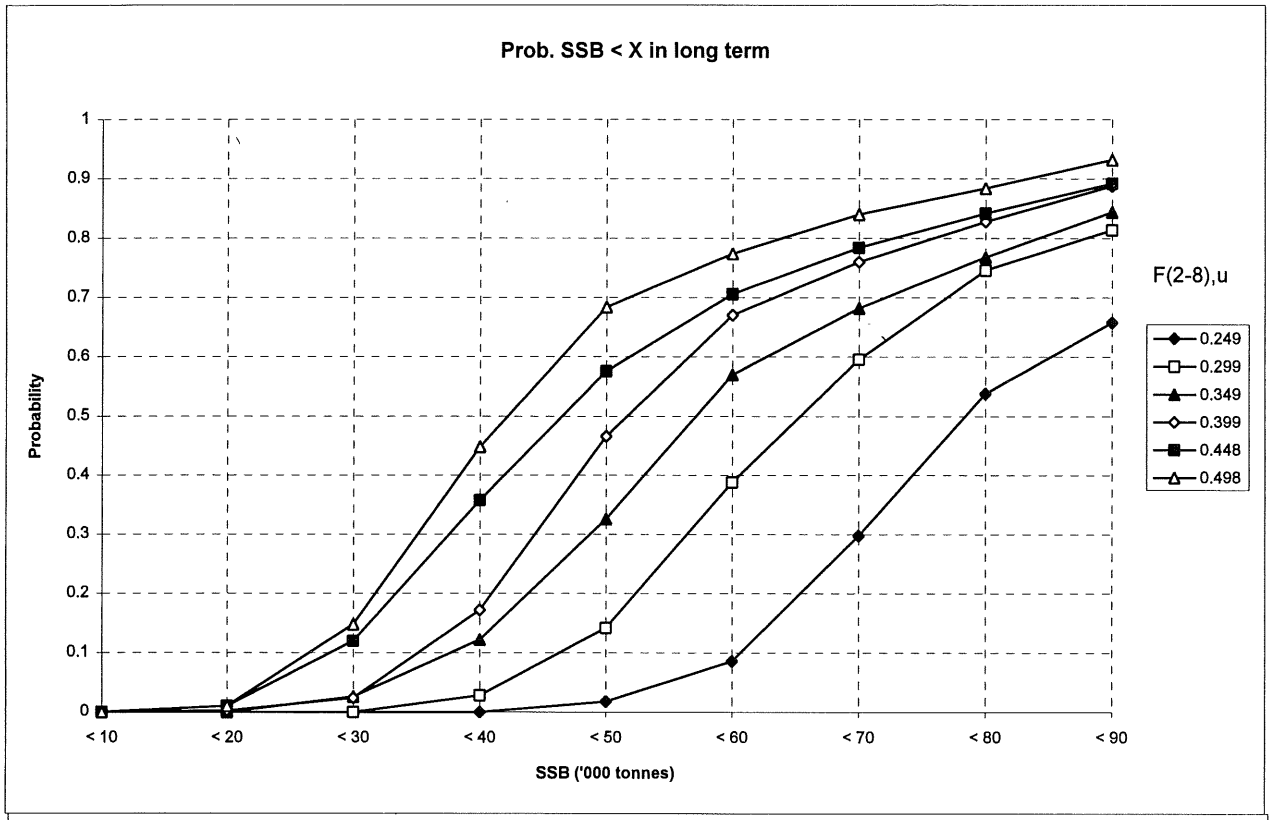


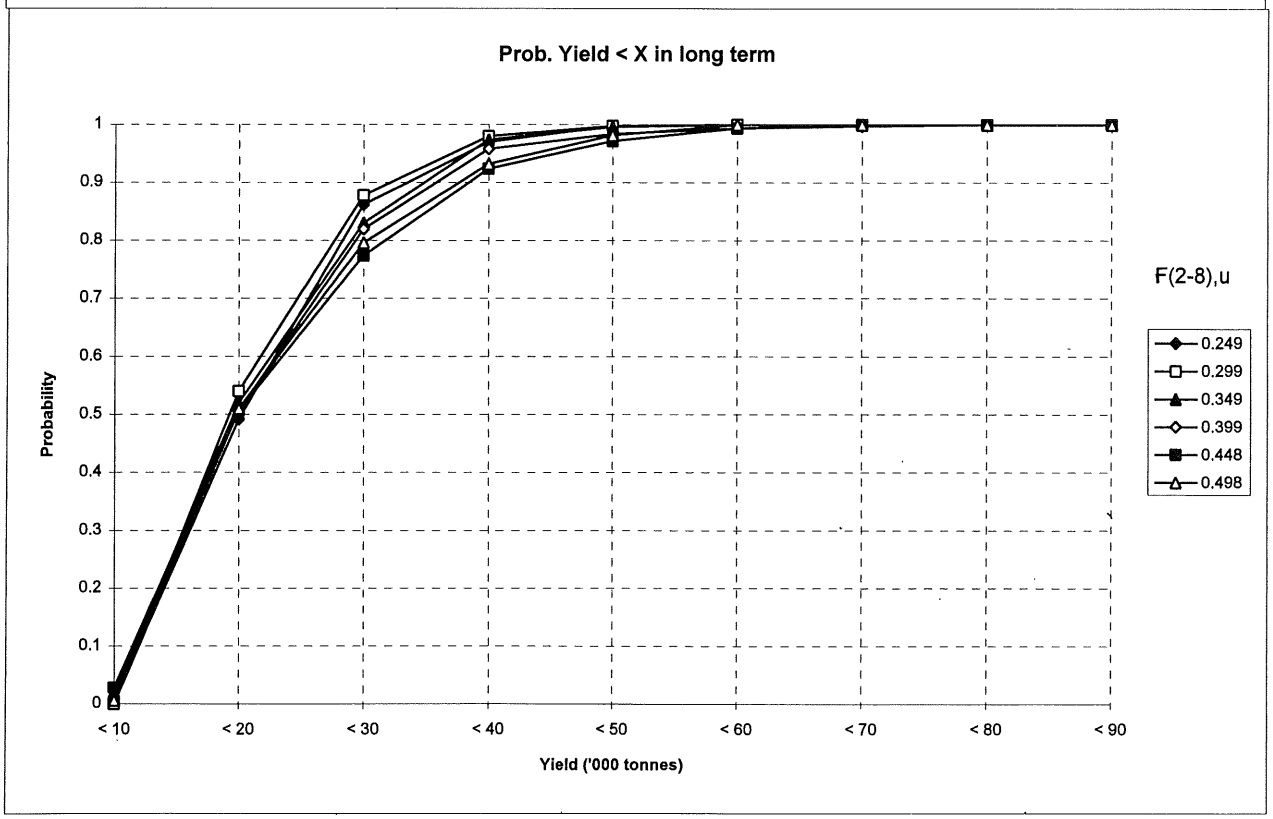


E:\acfm\wgnssk96\sol_nsea\fig6311.xls

Figure 3.6.12 **North Sea Sole**

Long term probability profiles of SSB and Yield for ranges of F between 0.5 - 1.0 times F94





E:\acfm\wgnssk96\sol_nsea\fig3612.xls

3.7 North Sea plaice

3.7.1 Catch trends and fisheries

Total international landings in 1994 were 111,000 t, slightly below the agreed TAC of 115,000 t and close to the *status quo* catch forecast of 113,00 t from last years assessment (Table 3.7.1, Figure 3.7.1). The 1993 and 1994 landings were the lowest since 1975. There are no indications of underreporting in 1993 and 1994. None of the major fisheries exhausted their quotas, therefore TAC was not restrictive. In previous years substantial amounts of plaice were landed but not reported. Until the mid 1980s estimates of unreported landings were based on formal sampling. In the second half of the 1980s estimates were based on interviews and tested against import - export statistics. The landings of plaice are mainly (70%) taken in mixed beam trawl fisheries by Netherlands, Belgium, England and Germany which targets at both sole and plaice. The remaining part is taken in a directed seine (UK, Denmark) and gill net fishery (Denmark) and mixed otter trawl fisheries (several countries).

3.7.2 Natural mortality, maturity, age composition and weight at age

Natural mortality and maturity were the conventional values used in previous years (Table 3.7.2). Maturation is taken as a crude step function representing the difference in age at maturation of males and females. The values are assumed to be constant over the years. The age compositions of the landings (Table 3.7.3) were not corrected for SOP-discrepancies and were based on a sampling coverage of about 90% of the total landings. SOP-discrepancy for 1994 was 0.99. SOP-discrepancies since 1958 are generally around 1 - 2% with maximum values up to 5%. Although it is known that substantial discarding occurs in the trawl fisheries for flatfish, no discard data are available to include in the assessment. Mean weights at age were estimated from market sampling data. Stock weights refer to the first quarter only, but values for age groups that are not yet fully recruited were extrapolated graphically (Table 3.7.5). The weights at age data refer to fresh weight. Inspection of Table 3.7.4 and 3.7.5 shows that weight at age has decreased considerably over the last 10 years. The decline in weight at age has stopped in the younger age groups, but continues in older age groups. Because of a change in the gutted-fresh conversion factor from 1.11 to 1.07 in a recent year, the time series of weight at age is inconsistent. This inconsistency is relatively minor because the Netherlands data, which represented a major part of the plaice landings, have been raised by 1.11 throughout the time series. The decline in weight at age reflects the decline in growth (Rijnsdorp & van Leeuwen, 1994).

3.7.3 Catch, effort, and research vessel data

The input data for the tuning are given in Table 3.7.6 and include two commercial CPUE series (Netherlands all fleet = beam trawl and UK seine) and two research survey series (Isis BTS Survey, Netherlands; Tridens SNS survey, Netherlands). The Isis BTS beam trawl survey, which targets at both pre-recruit and recruited age groups (age group >=1, is conducted in August-September and covers the southern and southeastern North Sea. The Tridens SNS survey targets at pre-recruits (age group 1, 2 and 3) along the continental coast of the southeastern North Sea. With the exception of the English seine data the commercial CPUE and survey data show a steady decrease in recent years and are at a historical low level (Figure. 3.7.5, Table 3.7.19). The results of the ISIS Netherlands beam trawl survey corroborates the decline in stock numbers (Table 3.7.20).

3.7.4 Catch at age analysis

Tuning was done by the XSA (with shrinkage) model. The model specifications are given in Table 3.7.7. A trial run showed that the catchability of the Netherlands commercial beam trawl fleet showed a substantial decline around 1989 (Figure 3.7.6). The decline may be related to the establishment of the "plaice box" in 1989 which has considerably affected the spatial distribution of this fleet. At present the effort is highly concentrated along the border of the box and may have reduced the overall catchability by being expelled from the local concentrations within the plaice box. However, this does not explain the decrease in q for older age groups which are not particularly abundant in the coastal waters. Because of the decline in q, it was decided to use the data of this fleet for the period since 1989 only. The default options were used: a tri-cubic time taper over 20 years, a 10 year tuning window and shrinkage to the mean (Table 3.7.7). Catchability was set independent of stock size, since only age group 4 and 5 in the Netherlands BTS Survey showed a significant relationship. The results of the tuning, given in Table 3.7.7, show that the terminal F of the groups 1 and 2 was mainly determined by the research vessel surveys, whereas the F of the older age groups was determined mainly by the commercial fleets, especially the Netherlands commercial beam trawl fleet. Log catchability residual plots do not show any change over time (Figure 3.7.6).

Because of the restriction of the Netherlands commercial beam trawl fleet data to the period 1989 - 1994 and its weight in the estimation of terminal F, the retrospective analysis was carried out using the full time series of this fleet but downweighting the older years by using a strong time taper (tri-cubic over 10 years). This approach was similar to the one used in last year's assessment and showed that the terminal F was close to the value for 1992 and 1993, but tended to be

overestimated in earlier years (Figure 3.7.8). Comparison of the final run using a restricted year range for the Netherlands commercial beam trawl fleet with the run using the full year range and a strong time taper shows that the former gives a slightly lower estimate of terminal F.

Results of the final VPA are given in Tables 3.7.8 to 3.7.10, and in Figures 3.7.1 - 3.7.4. The present analysis shows that the mean F2-10u has varied without a clear trend since 1979, although the values in the last four years (0.43-0.44) were slightly higher than before (Figure 3.7.2). The exploitation pattern shows a peak in fishing mortality at age 5 - 6. A shift in the exploitation pattern was observed from a peak at age 3 and 4 between 1980-1982 to a peak at age 5 or 6 between 1986-1993 (Table 3.7.8).

3.7.5 Recruitment estimates

For the forecast, the number of age-1 (year class 1993) in 1994 was estimated from the recruitment surveys. The input data for RCT3 is given in Table 3.7.11 and includes pre-recruit surveys covering all the major nursery areas of North Sea plaice at both the continental and the UK coast of the North Sea, as well as the ISIS BTS survey results (Netherlands) of age group 1, 2 and 3. The indices COMB-0 and COMB-1 are an average of the Netherlands/Belgian, German and UK-survey results for 0- and 1-group weighted over the surface area of the strata (Table 3.7.21). Results of the RCT3 are given in Table 3.7.12. Scatter plots of survey indices against VPA recruitment are shown in Figure. 3.7.7.

Recruitment estimates for the year classes since 1985 are given in the text table below. The estimates of the 1994 and 1995 year classes are preliminary and will be updated at the ACFM meeting in November 1995 when additional survey indices (combined 0- and 1-group) will become available. Based on the BTS (RV ISIS) and Tridens surveys, the preliminary estimate of the 1994 year class is 525 million at age-1 well above the AM recruitment over the period 1957-1990. Also the 1995 year class is estimated to be above average historic recruitment.

Year class	RCT3 prediction	VPA estimate	% difference
1985	981	1277	+30
1986	624	550	-12
1987	718	577	-20
1988	550	396	-28
1989	508	386	-26
1990	548	452	-18
1991	500	457*	-9
1992	300	312*	+4
1993	266	254*	-5
1994	525	-	
1995	530	-	

*VPA estimates have not yet converged

The RCT3 predictions are compared to the VPA-estimate. The comparison reveals a systematic discrepancy between the survey prediction and the VPA estimate of year classes born after 1985 for which the VPA is considered to have converged. As discussed in last years working group report there is some evidence that the accuracy of the recruitment estimates from surveys may have been affected by changes in the discard mortality level due to changes in pre-recruit growth. Comparison of the RCT3 results of individual surveys suggests that the predicted recruitment value of recent year classes tend to decline with the age of the surveyed cohorts (Table 3.7.12). This systematic bias emphasize the need to consider the recruitment estimates with caution.

3.7.6 Historical stock trends

Table 3.7.10 and Figures 3.7.1 - 3.7.4 show the trends in yield, mean F, SSB and recruitment from 1957-1992. The yield of the stock has increased continuously from about 80,000 t in the late 1950s to a record level of about 150,000 t in the 1980s. Since 1990, a sharp decrease in the landings can be observed. Fishing mortality increased in the 1970s and remained stable in the 1980s, but increased slightly to about 0.44 in 1991-1994. SSB has showed two peaks in the 1960s and 1980s, due to the recruitment of exceptionally strong year classes born in 1963 and in 1981 and 1985, respectively. Since 1990, SSB shows a sharp decline from 414,000 t in 1989 to a historic low value of 252,000 t in 1994. Recruitment is rather constant but varies periodically with low recruitment around 1970 and high recruitment between 1980-1988. Superimposed on this trend, three strong year classes occur which are related to low winter temperatures during the spawning season. Recruitment in most recent years appeared to have declined from the level of around 500-600 million in the mid 1980s to a level of around 400 million in the early 1990s.

3.7.7 Biological reference points

Input data for the yield per recruit are given in Table 3.7.13. Weights at age in the catch and stock were taken as the mean weights over the last three years to take account of the observed decrease in growth rate. The yield per recruit is flat topped and shows that the present level of F is about double that of Fmax (Table 3.7.14; Figure 3.7.10). The biological reference points are as follows:

F0.1	Fmax	Fmed	Fhigh	Fsq	Fbar(2-10)
0.10	0.24	0.28	0.48	0.44	0.34

The stock recruitment plot is shown in Figure 3.7.9. with lines indicating Fhigh and Fmed. The current value of Fsq=0.44, corresponding to 0.55 kg SSB/R, is well above Fmed = 0.28 (0.85 kg SSB/R) and at slightly below Fhigh=0.48 (0.50 kg SSB/R). For maintaining

SSB at the current level, above-average recruitment is needed. The stock-recruitment plot (S-R plot) suggests a dome shaped pattern with highest recruitment occurring at SSB levels around 300,000 t. The S-R-relationship, however, has to be interpreted with caution because it may be coincidental that the low R-values in the 1960s occurred at high levels of SSB. The dome-shaped S-R-relationship may reflect either density dependent population processes, a change in environmental conditions affecting pre-recruit survival, and/or a change in the discard mortality until the age of recruitment to the fisheries (age 2-5).

3.7.8 Short-term forecast

The short term forecast in this report is preliminary because additional recruitment survey estimates will become available before the ACFM meeting. The forecast was carried out using the data in Table 3.7.15. The exploitation pattern taken was the mean over the last three years scaled to the level of F2-10u in 1994. Weights at age in the catch and stock were taken as the mean weights over the last three years to take account of the observed decrease in growth rate. Recruitment in 1996 was crudely taken at 400 million, slightly below the GM recruitment. The stock numbers at age 1, 2 and 3 in 1995 were obtained from a RCT3 analysis of recruitment survey indices against VPA numbers at the respective age groups (Table 3.7.12a,b,c). The predicted *status quo* catch for 1995 is 100,000 t (Table 3.7.16), well below the agreed TAC of 115,000 t. The *status quo* catch for 1996 is 94,000 t. At *status quo* fishing mortality, the SSB will decline from 236,000 t in 1995 to 234,000 t in 1996 and 222,000 t in 1996. In terms of TAC predictions, the weight at age used in the predictions have been overestimated slightly (<2%) because of the conversion of gutted to fresh weight (see section 3.7.2). Reduction in fishing mortality in 1996 by 20% will result in a slight increase in the SSB and corresponds to a catch in 1996 of 78,490 t.

An analysis was conducted to determine the sensitivity of the short-term forecast to uncertainties in the input parameters. The input to this analysis is given in Table 3.7.17. Figure 3.7.11 indicates that the level of F in 1996 (HF96) is responsible for 39% of the variance in yield in 1996. Population numbers at age 1,2, and 3 contribute 25, 10 and 6% to the variance in yield, respectively. Variance in the estimated SSB in 1997 is mainly due to variance in the recruitment in 1996 (R96 - 40%) and 1995 (N1-31%).

Sensitivity coefficients illustrating the effect of a relative change in input parameters on the yield or SSB are shown in Figure 3.7.12. Yield in 1996 is most heavily affected by a change in the fishing mortality in 1996 and 1995. For SSB, an increase in F96 and F95 will result in a decrease in SSB. Other input parameters have a relatively modest effect. Cumulative probability profiles for landings in 1995 and 1996, and SSB in 1996 and 1997 are shown in Figure 3.7.14.

3.7.9 Medium term predictions

A medium-term prediction (10 year) was carried out assuming that recruitment is independent from spawning stock size and is randomly sampled from the observed distribution between 1960 and 1994. The other input parameters were similar to the yield per recruit analysis. Three runs of 1000 simulations each were carried out for *status quo* F = 1.0 x F94 and reduced fishing mortality of F = 0.8 x F94 and F = 0.6 x F94. Results in Figure 3.7.13 show the 5, 25, 50, 75 and 95 percentiles for SSB and yield together with the trajectories of 5 individual simulations. Conditional on the model assumptions, the *status quo* prediction indicates that the range of the predicted yield and SSB increases over the first five years and then stabilize. The 50% percentile for the stabilised period reflects the equilibrium situation. The range in yield and SSB indicates the effect of the variability in recruitment and of the variance (CV's) in input parameters on the variability in yield and SSB. At *status quo* fishing mortality, there is a 75% probability that SSB will decline further and stay well below the level of 300,000 which has been proposed as the acceptable minimum SSB (Anon. 1993). In order to raise the SSB in the medium term a reduction of fishing mortality is needed. When F is reduced to 0.8 x F94, there is a 75% probability that SSB will increase and stay above 260,000 t. The 50% percentile increases to 300,000 t. When F is reduced to 0.6 x F94, SSB will be above 300,000 t with a 95% probability.

3.7.10 Long-term considerations

For a level of SSB of about 300,000 t as observed between 1978-1992, there is no indication of a decline in recruitment (Figure 3.7.9), but the present SSB is at a historic low level. At the current level fishing mortality the SSB/R is 0.55 kg, corresponding to an SSB of 247,000 t at an average recruitment of 450 million, well below the level of 300,000 t. Due to the decrease in growth, the productivity of this stock has decreased and the SSB can only be maintained by above average recruitment.

3.7.11 Comments on the assessment

In previous years the Working Group observed an increasing discrepancy between the *status quo* catch forecast and the realized catch, suggesting that the assessment overestimated the size of the plaice stock. After a critical evaluation of the unreported landings, the Working Group revised the unreported landings downward on the basis of an analysis of the import and export statistics (Anon. 1995). The close correspondence between the current and last year's assessment suggests that the problems have been solved. The quality control

diagrams in Table 3.7.18 shows that the recent assessments have mainly altered the estimate of the recruitment.

TAC levels in recent years were not restricting the fisheries, hence the level of unreported landings was reduced substantially. However, in the near future, the problem may become pertinent again if restrictive TAC's are set.

With regard to the future evolution of the stock, there is concern about the recruitment to the fisheries. To clarify our thinking we have to distinguish between the number of pre-recruits (0-group) which settle on the nursery grounds and the survivors which will recruit to the landings. The VPA estimates of recruitment of the 1988, 1989 and 1990 year classes are at or below AM recruitment and well below the high level of recruitment in the early 1980s. The reduction in recruitment to the landings may be due to the decrease in growth rate observed since the late 1980s (Rijnsdorp & van Leeuwen, 1994) which may have lead to an increase in the time period during which pre-recruits are subjected to discard mortality (Anon. 1995). Without the "plaice box" the cumulative mortality might have been even bigger.

Spawning stock biomass has been calculated with a constant maturation ogive. This procedure will have caused biases in the estimated spawning stock biomass. Since 1957, substantial changes in growth and maturation have been observed. The stock recruitment plot therefore does not give the best estimate of the relationship between recruitment and reproductive effort of the spawning population. At the reduced level of growth, the recent decline in reproductive potential may have been even stronger than indicated by the SSB in this year's assessment. This aspect needs careful study before next year's assessment.

As the forecasted level of SSB in 1995 and 1996 is at a historically low value, there is a risk of a reduction in recruitment at the current low levels of SSB. The pre-recruit surveys, however, do show 'normal' levels of pre-recruits as reflected in average predictions of year class strength in recent years. Hence, there is no sign of recruitment failure. The above considerations nevertheless highlight the need for a better understanding of the nature of the stock-recruitment relationship in this stock, and the underlying processes such as the interplay of growth and (discard) mortality. Research on the factors affecting the observed changes in growth and its effect on discard mortality and recruitment, taking account of the effect of the plaice box, is urgently needed.

Table 3.7.1 North Sea PLAICE. Nominal landings (tonnes) in Sub-area IV as officially reported to ICES, 1983–1994.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	10,220	9,965	7,232	8,554	11,527	10,939	13,940	14,328	12,006	10,814	7,951
Denmark	23,361	28,236	26,332	21,597	20,259	23,481	26,474	24,356	20,891	16,452	17,058[1]
Faroe Islands	-	-	-	-	43	-	-	-	-	-	-
France	1,145	1,010	751	1,580	1,773	2,037[1]	1,339	508[1]	537[1]	593[1]	438[1]
Germany	2,485	2,197	1,809	1,794	2,566	5,341	8,747	7,926	6,818	6,896[1]	5,697
Netherlands	61,478	90,950	74,447	76,612	77,724	84,173	78,204	67,945	51,064	48,552	50,289
Norway	17	23	21	12	21	321	1,756	560	843[1]	753	551[1]
Sweden	14	18	16	7	2	12	169	103	53	7	6
UK (Engl. & Wales)	12,988	11,335	12,428	14,891	17,613	19,735	17,563	17,672	20,191	19,238	17,805
UK (N.Ireland)	-	-	-	-	-	540	176	992	1,268	1,384	1,323
UK (Scotland)	4,195	4,577	4,866	5,747	6,884	5,516	6,789	9,047	9,743	10,541	9,944
UK (Isle of Man)	-	-	-	-	-	-	-	-	64	-	-
Total reported	115,903	148,311	127,902	130,794	138,412	152,095	155,157	143,437	123,478	115,230	111,062
Unallocated landings[2]	40,244	11,526	37,445	22,876	16,063	17,548	1,050	4,041	1,234	-1	1
Landings as used by WG	156,147	159,837	165,347	153,670	154,475	169,643	156,207	147,478	124,712	115,229	111,063

[1]Provisional.
[2]Estimated by the Working Group.

TABLE 3.7.2 North sea plaice
Natural Mortality and proportion mature

Age	Nat Mor	Mat.
1	.100	.000
2	.100	.500
3	.100	.500
4	.100	1.000
5	.100	1.000
6	.100	1.000
7	.100	1.000
8	.100	1.000
9	.100	1.000
10	.100	1.000
11	.100	1.000
12	.100	1.000
13	.100	1.000
14	.100	1.000
15+	.100	1.000

Table 3.7.3 North Sea plaice.

Catch numbers at age Numbers*10**-3

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
1,	121,	1674,	0,	0,	1260,	1511,	1411,	3097,	3066,	1269,
2,	73552,	67125,	85123,	15146,	46709,	31759,	41876,	40163,	48571,	41364,
3,	144316,	163717,	115951,	250675,	105820,	96046,	81192,	79291,	91298,	95464,
4,	185203,	93801,	111239,	74335,	231176,	109536,	113577,	68348,	69650,	78100,
5,	32520,	84479,	64758,	47380,	52854,	160253,	72215,	69610,	50369,	40063,
6,	15544,	24049,	34728,	25011,	19227,	26889,	78212,	32641,	29413,	21657,
7,	6871,	9299,	11452,	16774,	10556,	8429,	15059,	29733,	13576,	16044,
8,	3650,	4490,	4341,	5381,	7553,	4409,	5490,	7028,	12589,	6778,
9,	2698,	2733,	2154,	3162,	2118,	3717,	3256,	3343,	4096,	6320,
10,	1543,	2026,	1743,	1671,	1691,	1176,	2556,	2420,	2219,	2832,
11,	1030,	1178,	1033,	932,	926,	767,	1035,	1731,	1582,	1174,
12,	1070,	1084,	663,	932,	630,	487,	667,	975,	1169,	854,
13,	727,	806,	529,	505,	446,	325,	394,	605,	860,	804,
14,	371,	628,	296,	517,	327,	235,	331,	609,	309,	487,
+gp,	1057,	1228,	1214,	1677,	1555,	1221,	1292,	1597,	1323,	1090,
TOTALNUM,	470273,	458317,	435224,	444098,	482848,	446760,	418563,	341191,	330090,	314300,
TONSLAND,	159838,	165347,	153670,	154475,	169643,	156207,	147478,	124712,	115229,	111063,
SOPCOF %,	98,	99,	99,	98,	99,	98,	97,	101,	98,	99,

Table 3.7.4 North Sea plaice.

Catch weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
1,	.2470,	.2210,	.2210,	.2210,	.2360,	.2710,	.2270,	.2510,	.2490,	.2330,
2,	.2640,	.2690,	.2490,	.2540,	.2800,	.2850,	.2860,	.2630,	.2730,	.2630,
3,	.2900,	.3040,	.3000,	.2780,	.3080,	.2980,	.2950,	.2910,	.2900,	.2870,
4,	.3370,	.3470,	.3510,	.3520,	.3310,	.3180,	.3060,	.3200,	.3270,	.3400,
5,	.4620,	.4250,	.4020,	.4530,	.3900,	.3680,	.3670,	.3440,	.3580,	.3920,
6,	.5770,	.4880,	.5040,	.5120,	.5320,	.4480,	.4560,	.4270,	.4240,	.4390,
7,	.6780,	.6750,	.5830,	.6080,	.6000,	.5960,	.5290,	.5310,	.5190,	.4960,
8,	.7290,	.7510,	.7280,	.7000,	.6670,	.6870,	.6640,	.6030,	.6180,	.5900,
9,	.8040,	.8530,	.8290,	.8130,	.7900,	.7520,	.7380,	.7040,	.6920,	.6940,
10,	.9000,	.9210,	.8260,	.9360,	.8190,	.8170,	.8220,	.7370,	.7540,	.7280,
11,	1.0010,	.9480,	.9960,	.9640,	.9170,	1.0250,	.9020,	.8090,	.7680,	.8500,
12,	.9500,	1.0630,	1.0150,	1.0410,	.9480,	1.0770,	.9170,	.9240,	.8730,	.8650,
13,	1.0710,	1.0780,	1.0450,	1.1370,	1.1390,	1.0960,	.9790,	.9690,	.8230,	.9130,
14,	1.1390,	1.0740,	1.1270,	1.1150,	1.0800,	.9680,	.9440,	.8790,	.8670,	.7800,
+gp,	1.2150,	1.1100,	1.1500,	1.0380,	.9930,	1.0750,	1.0040,	1.0590,	1.0350,	.9740,
SOPCOFAC,	.9799,	.9877,	.9875,	.9850,	.9885,	.9827,	.9650,	1.0103,	.9791,	.9859,

Table 3.7.5 **North Sea plaice.**

Stock weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
1,	.1500,	.1500,	.1500,	.1500,	.1500,	.1500,	.1310,	.1310,	.1310,	.1310,
2,	.2080,	.1950,	.1940,	.2120,	.2150,	.2450,	.2080,	.2630,	.2570,	.2220,
3,	.2430,	.2530,	.2650,	.2380,	.2510,	.2720,	.2630,	.2910,	.2640,	.2490,
4,	.3100,	.3360,	.3300,	.3150,	.2810,	.2820,	.2760,	.3200,	.3030,	.3010,
5,	.4520,	.4400,	.4010,	.4260,	.3590,	.3430,	.3420,	.3440,	.3300,	.3600,
6,	.5360,	.5330,	.5030,	.4670,	.4840,	.4220,	.4010,	.4270,	.3910,	.4040,
7,	.6350,	.6920,	.5730,	.5470,	.5510,	.5550,	.4630,	.5310,	.4900,	.4620,
8,	.6560,	.7790,	.7110,	.6440,	.6120,	.6470,	.6330,	.6030,	.5870,	.5320,
9,	.7640,	.8880,	.7470,	.7060,	.7590,	.7040,	.6520,	.7040,	.6330,	.6510,
10,	.8690,	.9710,	.8170,	.8970,	.8370,	.7600,	.7440,	.7370,	.7230,	.6980,
11,	.9550,	.9530,	1.0090,	.9370,	.7870,	1.0170,	.8240,	.8090,	.7610,	.8600,
12,	.9060,	1.1070,	1.0180,	1.0090,	.9680,	1.1440,	.9600,	.9240,	.9140,	.8730,
13,	1.0680,	1.1530,	1.0190,	1.0650,	1.2150,	.9960,	.9510,	.9690,	.7950,	.9340,
14,	1.1080,	1.1260,	1.2140,	1.1350,	.8990,	1.0460,	.8250,	.8790,	.8160,	.6940,
+gp,	1.3080,	1.3540,	1.1140,	.9720,	.8570,	1.0680,	.8910,	1.0590,	.9670,	.8850,

Table 3.7.6 Tuning input data.

16:06 Tuesday, October 3, 1995

PLE-NSEA: Plaice in the North Sea (Fishing Area IV)

FLT01: Neth Comm BT (Catch: Thousands)

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8
1989	72.5	1151.3	40443.3	73696.3	131915.1	23063.6	9633.8	5239.6	2714.5
1990	71.4	173.7	21956.4	60038.4	49861.6	76520.9	12186.9	3682.3	1790.2
1991	68.5	426.9	27501.1	42376.4	53151.7	30697.4	34092.3	6878.9	1954.4
1992	71.1	1810.1	24270.5	44306.1	31854.1	27165.2	12219.3	9485.1	2463.9
1993	76.9	2363.5	26506.8	44770.9	30144.9	18957.3	10567.3	5810.9	3474.2
1994	81.1	649.4	29800.8	47478.6	35432.8	15170.5	7834.2	6093.8	2828.5

Year	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1989	947.4	630.6	304.1	168.4	149.0	68.7	143.5
1990	1160.8	491.5	250.8	171.3	101.8	63.7	118.4
1991	1137.4	652.1	285.8	122.4	66.9	73.0	111.6
1992	992.8	508.2	312.9	262.8	95.2	75.3	129.3
1993	986.0	514.4	243.0	167.4	89.6	33.8	58.7
1994	1903.9	707.5	251.8	119.7	78.0	31.5	46.0

16:06 Tuesday, October 3, 1995

PLE-NSEA: Plaice in the North Sea (Fishing Area IV)

FLT02: English seine

ear	Fishing effort	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10	Catch, age 11	Catch, age 12	Catch, age 13	Catch, age 14	Catch, age 15
1982	160.6	44.4	3887.4	3202.2	1996.9	985.3	332.2	132.2	371.6	427.1	85.4	45.4	36.4	37.1	244.8
1983	156.0	1539.7	2602.1	5926.2	1993.0	911.9	536.5	122.0	68.9	184.8	117.3	10.4	30.6	12.7	142.5
1984	144.7	400.0	5372.1	2497.3	2169.5	679.8	378.2	283.3	120.9	74.6	65.3	104.4	71.0	37.0	222.1
1985	138.9	1168.0	2968.5	5471.5	663.2	622.2	284.0	175.1	104.1	25.6	38.9	36.1	30.3	20.8	136.4
1986	121.0	282.5	4316.2	2631.9	1953.4	270.5	206.3	169.4	205.9	106.4	56.5	31.7	46.3	26.3	272.6
1987	112.7	792.7	1896.1	2729.0	2078.0	1085.3	362.0	188.6	58.6	67.2	30.6	15.1	33.9	9.7	65.4
1988	78.8	129.0	3071.8	1508.6	1048.7	819.5	402.0	91.1	78.4	37.8	23.9	13.4	104.8	20.8	117.3
1989	83.6	48.2	625.2	4324.9	1915.1	898.0	385.9	515.6	73.1	108.0	71.9	56.5	26.2	16.4	129.6
1990	73.1	120.2	1227.3	1673.6	4296.7	495.0	332.1	169.9	146.8	45.8	25.8	19.0	14.5	14.3	90.5
1991	67.0	130.0	504.1	1078.5	1002.9	1517.4	246.9	116.6	64.1	87.7	33.8	26.2	18.1	17.4	69.0
1992	60.0	177.4	1039.2	1015.8	1145.5	549.2	497.3	140.6	56.9	39.3	52.5	12.3	14.7	10.4	44.6
1993	52.8	66.3	898.0	1140.3	837.7	566.3	151.1	228.5	72.2	36.1	30.7	20.5	8.7	4.9	23.9
1994	32.3	243.4	954.8	722.6	463.2	302.2	136.2	36.5	68.3	31.0	12.7	7.0	10.0	7.6	20.6

16:06 Tuesday, October 3, 1995

PLE-NSEA: Plaice in the North Sea (Fishing Area IV)

FLT03: NETH BTS Survey

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3	Catch, age 4	Catch, age 5	Catch, age 6	Catch, age 7	Catch, age 8	Catch, age 9	Catch, age 10
1985	1	105.67	185.90	39.49	13.33	1.50	1.02	0.52	0.16	0.20	0.45
1986	1	634.26	125.85	50.38	10.18	4.69	0.91	0.49	0.25	0.07	0.24
1987	1	207.67	707.45	32.12	9.46	2.67	1.54	0.33	0.18	0.10	0.25
1988	1	541.24	151.10	207.99	6.78	3.05	0.74	0.57	0.13	0.14	0.26
1989	1	398.00	337.87	56.08	51.10	7.89	1.13	0.42	0.25	0.07	0.32
1990	1	123.15	122.13	67.36	22.32	10.20	1.13	0.28	0.23	0.07	0.12
1991	1	187.16	125.54	30.11	21.64	5.36	4.58	0.59	0.17	0.08	0.21
1992	1	179.56	117.20	20.62	6.10	4.97	2.88	1.41	0.39	0.04	0.09
1993	1	124.92	164.11	36.89	7.26	1.77	1.54	0.51	0.47	0.15	0.13
1994	1	152.75	65.20	32.24	10.33	2.08	0.62	0.66	1.34	0.33	0.06

16:06 Tuesday, October 3, 1995

PLE-NSEA: Plaice in the North Sea (Fishing Area IV)

FLT04: TRIDENS SNS September survey

Year	Fishing effort	Catch, age 1	Catch, age 2	Catch, age 3
1982	1	70108	8503	1146
1983	1	34884	14708	308
1984	1	44667	10413	2480
1985	1	27832	13789	1584
1986	1	93573	7558	1155
1987	1	33426	33021	1232
1988	1	36672	14430	13140
1989	1	37238	14952	3709
1990	1	24903	7287	3248
1991	1	57349	11148	1507
1992	1	48223	13742	2257
1993	1	22184	9484	988
1994	1	18225	4866	884

Table 3.7.7 North Sea plaice: XSA tuning diagnostics and results.

```
Lowestoft VPA Version 3.1

   4-Oct-95  09:23:55

Extended Survivors Analysis

Plaice in IV (run: FINAL/015)

CPUE data from file /users/fish/ifad/ifapwork/wgnssk/ple_nsea/FLEET.015

Catch data for  38 years. 1957 to 1994. Ages  1 to  15.

     Fleet,           First, Last, First, Last, Alpha,  Beta
                       year, year,  age ,  age
FLT01: Neth Comm BT ,  1989, 1994,   1,    14,   .000,  1.000
FLT02: English seine,  1985, 1994,   2,    14,   .000,  1.000
FLT03: NETH BTS Surv,  1985, 1994,   1,    10,   .660,   .750
FLT04: TRIDENS SNS S,  1985, 1994,   1,     3,   .660,   .750


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability independent of stock size for all ages

     Catchability independent of age for ages >=   10


Terminal population estimation :

     Survivor estimates shrunk towards the mean F
     of the final   5 years or the   5 oldest ages.

     S.E. of the mean to which the estimates  are shrunk =    .500

     Minimum standard error for population
     estimates derived from each fleet =    .300

     Prior weighting not applied


Tuning converged after   65 iterations



Fleet : FLT01: Neth Comm BT

Regression statistics :


Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 1,   -7.62,    -.535,     31.31,     .00,      6,    8.19,  -10.39,
 2,    1.94,   -1.142,      1.12,     .27,      6,     .38,   -6.80,
 3,    1.06,    -.180,      5.60,     .71,      6,     .14,   -5.99,
 4,     .84,    2.449,      6.82,     .98,      6,     .07,   -5.74,
 5,     .79,    3.165,      6.95,     .98,      6,     .07,   -5.66,
 6,     .81,    1.224,      6.78,     .92,      6,     .15,   -5.76,
 7,    1.12,    -.489,      5.40,     .82,      6,     .18,   -5.94,
 8,    1.54,   -2.319,      4.26,     .82,      6,     .16,   -6.30,
 9,    1.69,   -2.349,      4.51,     .75,      6,     .21,   -6.56,
10,    2.32,   -1.440,      3.61,     .23,      6,     .36,   -6.63,
11,    1.80,   -2.576,      5.70,     .72,      6,     .14,   -6.92,
12,     .83,     .378,      7.24,     .57,      6,     .18,   -7.08,
13,    -.99,   -2.415,      8.16,     .27,      6,     .26,   -7.28,
14,     .65,     .833,      7.38,     .59,      6,     .20,   -7.42,
```

Table 3.7.7 Continued

Fleet : FLT02: English seine

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	2.68,	-.749,	10.32,	.03,	10,	2.46,	-12.02,
3,	1.34,	-.463,	8.74,	.21,	10,	.74,	-9.78,
4,	1.30,	-1.061,	8.01,	.64,	10,	.31,	-9.03,
5,	.85,	.500,	9.15,	.61,	10,	.35,	-8.68,
6,	1.05,	-.099,	8.57,	.36,	10,	.55,	-8.69,
7,	.92,	.278,	9.05,	.62,	10,	.28,	-8.92,
8,	.77,	.587,	9.19,	.47,	10,	.35,	-8.97,
9,	.88,	.356,	9.12,	.54,	10,	.29,	-9.08,
10,	.94,	.050,	9.02,	.08,	10,	.53,	-9.03,
11,	1.64,	-.415,	9.43,	.05,	10,	.76,	-9.05,
12,	317.70,	-.986,	361.92,	.00,	10,	157.24,	-9.22,
13,	-2.31,	-1.131,	5.48,	.02,	10,	1.40,	-8.76,

Fleet : FLT04: TRIDENS SNS S

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	1.07,	-.289,	1.71,	.68,	10,	.31,	-2.50,
2,	.85,	.749,	4.94,	.78,	10,	.22,	-3.55,
3	.55	1.697	8.54	.66.	10.	.27.	-4.96.

Fleet : FLT03: NETH BTS Surv

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	1.05,	-.117,	7.31,	.42,	10,	.53,	-7.59,
2,	.64,	2.249,	9.65,	.85,	10,	.17,	-7.78,
3,	.58,	4.933,	10.49,	.95,	10,	.09,	-8.76,
4,	.64,	1.991,	10.59,	.81,	10,	.20,	-9.52,
5,	.74,	1.106,	10.50,	.71,	10,	.27,	-10.03,
6,	.68,	1.639,	10.63,	.78,	10,	.22,	-10.39,
7,	.81,	.905,	10.71,	.76,	10,	.20,	-10.75,
8,	.77,	.436,	10.63,	.32,	10,	.48,	-10.85,
9,	.77,	.481,	10.92,	.37,	10,	.41,	-11.38,
10,	-.61,	-1.856,	8.02,	.15,	10,	.36,	-10.32,

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	246765.,	1.075,	.000,	.00,	1,	.043,	.005
FLT02: English seine,	1.,	.000,	.000,	.00,	0,	.000,	.000
FLT03: NETH BTS Surv,	293778.,	.502,	.000,	.00,	1,	.199,	.004
FLT04: TRIDENS SNS S,	214205.,	.300,	.000,	.00,	1,	.557,	.006
F shrinkage mean ,	212505.,	.50,,,,				.201,	.006

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
229105.,	.22,	.07,	4,	.331,	.005

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	307085.,	.289,	.237,	.82,	2,	.229,	.121
FLT02: English seine,	1089762.,	.941,	.000,	.00,	1,	.022,	.035
FLT03: NETH BTS Surv,	155784.,	.285,	.111,	.39,	2,	.235,	.225
FLT04: TRIDENS SNS S,	176021.,	.212,	.122,	.57,	2,	.423,	.202
F shrinkage mean ,	322427.,	.50,,,,				.091,	.115

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
213499.,	.14,	.15,	8,	1.106,	.169

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	183043.,	.209,	.104,	.50,	3,	.287,	.403
FLT02: English seine,	304903.,	.480,	.536,	1.12,	2,	.056,	.261
FLT03: NETH BTS Surv,	193515.,	.210,	.089,	.42,	3,	.283,	.385
FLT04: TRIDENS SNS S,	209981.,	.200,	.219,	1.10,	3,	.297,	.359
F shrinkage mean ,	237495.,	.50,,,,				.077,	.324

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
203334.,	.11,	.08,	12,	.708,	.369

Table 3.7.7 Continued

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	99042.,	.175,	.049,	.28,	4,	.312,	.560
FLT02: English seine,	137749.,	.257,	.023,	.09,	3,	.166,	.431
FLT03: NETH BTS Surv,	108957.,	.188,	.052,	.28,	4,	.256,	.520
FLT04: TRIDENS SNS S,	155930.,	.200,	.235,	1.18,	3,	.189,	.390
F shrinkage mean ,	111924.,	.50,,,,				.077,	.509

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
117916.,	.10,	.06,	15,	.630,	.489

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	41195.,	.163,	.104,	.64,	5,	.348,	.655
FLT02: English seine,	59447.,	.229,	.035,	.15,	4,	.186,	.495
FLT03: NETH BTS Surv,	36355.,	.184,	.076,	.41,	5,	.249,	.717
FLT04: TRIDENS SNS S,	48948.,	.201,	.179,	.89,	3,	.118,	.576
F shrinkage mean ,	43420.,	.50,,,,				.099,	.630

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
43862.,	.10,	.06,	18,	.580,	.625

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	20543.,	.162,	.025,	.15,	6,	.377,	.695
FLT02: English seine,	26495.,	.232,	.154,	.66,	5,	.168,	.575
FLT03: NETH BTS Surv,	16944.,	.190,	.106,	.56,	6,	.260,	.796
FLT04: TRIDENS SNS S,	21225.,	.203,	.135,	.67,	3,	.074,	.678
F shrinkage mean ,	27799.,	.50,,,,				.121,	.554

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
21204.,	.11,	.06,	21,	.536,	.679

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	20576.,	.156,	.053,	.34,	6,	.349,	.555
FLT02: English seine,	21479.,	.205,	.096,	.47,	6,	.234,	.537
FLT03: NETH BTS Surv,	26960.,	.177,	.067,	.38,	7,	.287,	.449
FLT04: TRIDENS SNS S,	23635.,	.205,	.138,	.67,	3,	.042,	.498
F shrinkage mean ,	25945.,	.50,,,,				.087,	.463

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
23056.,	.10,	.04,	23,	.425,	.508

Table 3.7.7 Continued

Age 8 Catchability constant w.r.t. time and dependent on age

Year class = 1986

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	14111.,	.160,	.026,	.16,	6,	.400,	.376
FLT02: English seine,	9111.,	.202,	.091,	.45,	7,	.240,	.535
FLT03: NETH BTS Surv,	19115.,	.183,	.219,	1.20,	8,	.241,	.291
FLT04: TRIDENS SNS S,	13724.,	.209,	.168,	.80,	3,	.028,	.385
F shrinkage mean ,	13946.,	.50,,,,				.090,	.380

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
13646.,	.10,	.08,	25,	.806,	.387

Age 9 Catchability constant w.r.t. time and dependent on age

Year class = 1985

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	14307.,	.159,	.078,	.49,	6,	.411,	.351
FLT02: English seine,	16392.,	.192,	.040,	.21,	8,	.292,	.312
FLT03: NETH BTS Surv,	22151.,	.201,	.075,	.37,	9,	.199,	.240
FLT04: TRIDENS SNS S,	19325.,	.215,	.230,	1.07,	3,	.014,	.271
F shrinkage mean ,	14998.,	.50,,,,				.083,	.337

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
16375.,	.10,	.05,	27,	.435,	.313

Age 10 Catchability constant w.r.t. time and dependent on age

Year class = 1984

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	4900.,	.150,	.054,	.36,	6,	.456,	.438
FLT02: English seine,	5264.,	.184,	.047,	.26,	9,	.258,	.413
FLT03: NETH BTS Surv,	4323.,	.198,	.180,	.91,	10,	.180,	.484
FLT04: TRIDENS SNS S,	3298.,	.224,	.013,	.06,	3,	.012,	.597
F shrinkage mean ,	6497.,	.50,,,,				.094,	.347

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
4987.,	.10,	.05,	29,	.518,	.432

Age 11 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1983

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	2247.,	.151,	.069,	.46,	6,	.476,	.403
FLT02: English seine,	2624.,	.190,	.052,	.27,	10,	.280,	.355
FLT03: NETH BTS Surv,	1680.,	.204,	.104,	.51,	9,	.134,	.510
FLT04: TRIDENS SNS S,	2084.,	.305,	.246,	.81,	2,	.003,	.429
F shrinkage mean ,	3117.,	.50,,,,				.107,	.306

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2336.,	.11,	.05,	28,	.435,	.391

Age 12 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1982

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	1293.,	.159,	.119,	.75,	6,	.445,	.488
FLT02: English seine,	1661.,	.196,	.072,	.37,	10,	.304,	.398
FLT03: NETH BTS Surv,	1182.,	.209,	.081,	.39,	8,	.111,	.523
FLT04: TRIDENS SNS S,	1179.,	.669,	.000,	.00,	1,	.001,	.524
F shrinkage mean ,	2531.,	.50,,,,				.139,	.278

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1517.,	.12,	.07,	26,	.575,	.429

Age 13 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1981

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	1152.,	.168,	.145,	.86,	6,	.418,	.509
FLT02: English seine,	2062.,	.197,	.078,	.40,	10,	.326,	.315
FLT03: NETH BTS Surv,	1236.,	.225,	.085,	.38,	7,	.099,	.482
FLT04: TRIDENS SNS S,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	2180.,	.50,,,,				.157,	.301

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1550.,	.13,	.08,	24,	.657,	.401

Age 14 Catchability constant w.r.t. time and age (fixed at the value for age) 10

Year class = 1980

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FLT01: Neth Comm BT ,	635.,	.185,	.173,	.94,	6,	.285,	.548
FLT02: English seine,	1028.,	.183,	.146,	.80,	10,	.491,	.372
FLT03: NETH BTS Surv,	600.,	.231,	.064,	.28,	6,	.077,	.572
FLT04: TRIDENS SNS S,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	959.,	.50,,,,				.147,	.394

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
851.,	.13,	.09,	23,	.727,	.435

Table 3.7.8 **North Sea plaice.**

Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
1,	.0002,	.0014,	.0000,	.0000,	.0034,	.0041,	.0033,	.0072,	.0104,	.0053,	.0076,
2,	.1502,	.1572,	.0808,	.0326,	.0989,	.0985,	.1353,	.1093,	.1329,	.1691,	.1371,
3,	.4417,	.5085,	.3931,	.3200,	.2950,	.2696,	.3460,	.3612,	.3428,	.3692,	.3577,
4,	.6739,	.5090,	.6885,	.4173,	.4850,	.4985,	.5183,	.4856,	.5489,	.4886,	.5077,
5,	.4212,	.6634,	.7058,	.6280,	.5225,	.6505,	.6364,	.6162,	.7115,	.6253,	.6510,
6,	.4388,	.5587,	.5580,	.5758,	.4975,	.4875,	.6819,	.5878,	.5072,	.6788,	.5913,
7,	.3565,	.4528,	.5007,	.5089,	.4512,	.3744,	.4924,	.5289,	.4584,	.5080,	.4984,
8,	.2839,	.3700,	.3502,	.4117,	.4007,	.3054,	.3958,	.3977,	.3948,	.3870,	.3931,
9,	.2996,	.3170,	.2710,	.4119,	.2505,	.3121,	.3447,	.3957,	.3777,	.3127,	.3621,
10,	.2609,	.3423,	.3051,	.3105,	.3585,	.1920,	.3263,	.4125,	.4403,	.4319,	.4282,
11,	.2035,	.2897,	.2614,	.2368,	.2523,	.2435,	.2305,	.3407,	.4603,	.3907,	.3972,
12,	.4004,	.3045,	.2345,	.3536,	.2226,	.1825,	.3079,	.3145,	.3609,	.4289,	.3681,
13,	.2750,	.5275,	.2131,	.2516,	.2540,	.1533,	.1972,	.4485,	.4467,	.4010,	.4321,
14,	.2930,	.3599,	.3312,	.2965,	.2291,	.1844,	.2064,	.4659,	.3849,	.4346,	.4285,
+gp,	.2930,	.3599,	.3312,	.2965,	.2291,	.1844,	.2064,	.4659,	.3849,	.4346,	
FBAR 2-10,	.3696,	.4310,	.4281,	.4019,	.3733,	.3543,	.4308,	.4328,	.4349,	.4412,	
FBARC,	.4444,	.4633,	.5109,	.4316,	.3830,	.4040,	.4322,	.4221,	.4368,	.4228,	
FBARP,	.2361,	.2480,	.2322,	.2004,	.2075,	.2071,	.2294,	.2249,	.2326,	.2376,	

Table 3.7.9 **North Sea plaice.**

Stock number at age (start of year) Numbers*10**-3

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST
AGE												
1,	536169,	1276141,	549466,	576079,	394633,	386039,	452114,	456737,	312050,	254534,	0,	4318
2,	554539,	485031,	1153107,	497177,	521259,	355880,	347865,	407748,	410326,	279438,	229105,	3811
3,	424930,	431803,	375023,	962403,	435457,	427223,	291804,	274928,	330741,	325077,	213499,	3141
4,	397120,	247215,	234979,	229038,	632369,	293359,	295206,	186803,	173341,	212422,	203334,	2095
5,	99460,	183159,	134463,	106804,	136533,	352289,	161248,	159075,	104011,	90592,	117916,	1247
6,	46009,	59061,	85370,	60067,	51571,	73264,	166327,	77210,	77722,	46201,	43862,	706
7,	24090,	26845,	30565,	44212,	30560,	28374,	40714,	76102,	38814,	42347,	21204,	425
8,	15524,	15261,	15444,	16763,	24048,	17610,	17656,	22515,	40577,	22206,	23056,	268
9,	10957,	10575,	9538,	9845,	10049,	14575,	11741,	10754,	13687,	24740,	13646,	180
10,	7064,	7348,	6969,	6581,	5901,	7078,	9653,	7526,	6550,	8489,	16375,	126
11,	5881,	4924,	4722,	4647,	4366,	3731,	5286,	6303,	4508,	3816,	4987,	88
12,	3409,	4342,	3335,	3290,	3319,	3069,	2646,	3798,	4056,	2574,	2336,	61
13,	3178,	2067,	2897,	2387,	2090,	2403,	2314,	1760,	2509,	2558,	1517,	42
14,	1536,	2184,	1104,	2118,	1679,	1467,	1866,	1719,	1017,	1452,	1550,	1
+gp,	4362,	4257,	4512,	6852,	7967,	7607,	7267,	4489,	4338,	3238,	2748,	
TOTAL,	2134229,	2760210,	2611493,	2528265,	2261799,	1973971,	1813706,	1697465,	1524250,	1319686,	895135,	

Table 3.7.10 North Sea plaice.

Run title : Plaice in IV (run: FINAL/015)

At 4-Oct-95 09:24:41

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 1	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2-10,	FBARC,	FBARP,
1957,	296171,	457380,	354630,	70563,	.1990,	.1973,	.2317,	.1376,
1958,	429991,	443687,	340643,	73354,	.2153,	.2118,	.2500,	.1413,
1959,	433453,	457578,	345195,	79300,	.2297,	.2266,	.2434,	.1430,
1960,	405340,	497710,	368323,	87541,	.2377,	.2469,	.2815,	.1535,
1961,	359400,	461944,	352891,	85984,	.2437,	.2331,	.2822,	.1396,
1962,	318830,	564486,	446592,	87472,	.1959,	.2345,	.2839,	.1407,
1963,	315197,	547191,	440003,	107118,	.2434,	.2644,	.3224,	.1479,
1964,	1022014,	624878,	422967,	110540,	.2613,	.2731,	.3037,	.1653,
1965,	309596,	580548,	414399,	97143,	.2344,	.2761,	.3025,	.1571,
1966,	305435,	588047,	416440,	101834,	.2445,	.2594,	.3091,	.1462,
1967,	277278,	590927,	493087,	108819,	.2207,	.2427,	.2927,	.1424,
1968,	245600,	548290,	456191,	111534,	.2445,	.2209,	.2341,	.1422,
1969,	327576,	526389,	418385,	121651,	.2908,	.2538,	.2572,	.1604,
1970,	370547,	525979,	399707,	130342,	.3261,	.3329,	.3804,	.1984,
1971,	275704,	500729,	372523,	113944,	.3059,	.3154,	.2988,	.1796,
1972,	234856,	495471,	376033,	122843,	.3267,	.3408,	.3057,	.2024,
1973,	542529,	488457,	334998,	130429,	.3893,	.3803,	.3858,	.2291,
1974,	451755,	467638,	309199,	112540,	.3640,	.3909,	.4347,	.2152,
1975,	337419,	495663,	320485,	108536,	.3387,	.3648,	.3803,	.1885,
1976,	326519,	451679,	315208,	113670,	.3606,	.3142,	.2967,	.1911,
1977,	473311,	480107,	330175,	119188,	.3610,	.3335,	.3305,	.2093,
1978,	433049,	475868,	324061,	113984,	.3517,	.3271,	.3398,	.2122,
1979,	446128,	475410,	311456,	145347,	.4667,	.4545,	.4513,	.2486,
1980,	661873,	489022,	297864,	139951,	.4698,	.3942,	.4952,	.2599,
1981,	427847,	490394,	308836,	139747,	.4525,	.3954,	.4541,	.2532,
1982,	1030719,	562693,	302303,	154547,	.5112,	.4334,	.5429,	.2614,
1983,	593775,	551285,	326386,	144038,	.4413,	.4110,	.4893,	.2490,
1984,	612974,	562655,	328307,	156147,	.4756,	.3762,	.4234,	.2301,
1985,	536169,	551249,	361522,	159838,	.4421,	.3696,	.4444,	.2361,
1986,	1276141,	657477,	364143,	165347,	.4541,	.4310,	.4633,	.2480,
1987,	549466,	638698,	394736,	153670,	.3893,	.4281,	.5109,	.2322,
1988,	576080,	633676,	380037,	154475,	.4065,	.4019,	.4316,	.2004,
1989,	394633,	593883,	424003,	169643,	.4001,	.3733,	.3830,	.2075,
1990,	386039,	557921,	398318,	156207,	.3922,	.3543,	.4040,	.2071,
1991,	452114,	473622,	339844,	147478,	.4340,	.4308,	.4322,	.2294,
1992,	456737,	478224,	324771,	124712,	.3840,	.4328,	.4221,	.2249,
1993,	312050,	421278,	284015,	115229,	.4057,	.4349,	.4368,	.2326,
1994,	254534,	356742,	251908,	111063,	.4409,	.4412,	.4228,	.2376,
Arith. Mean ,	459443,	520128,	361857,	122257,	.3461,	.3369,	.0000,	.1974,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),				

Table 3.7.11 North Sea plaice: RCT3 input (for 1-year-olds).

Plaice North Sea - 1-Y-Rcr.												
11	29	2										
1967	246	-11	-11	-11	-11	-11	2813	-11	-11	-11	-11	-11
1968	328	-11	-11	-11	7708	9450	1008	-11	-11	-11	-11	-11
1969	371	-11	8641	8032	-11	23848	4484	-11	-11	-11	-11	-11
1970	276	3678	-11	18101	14840	9584	1631	-11	-11	-11	-11	-11
1971	235	6708	9799	6437	8738	4191	1261	-11	-11	-11	-11	-11
1972	542	9242	32980	57238	43774	17985	10744	-11	-11	-11	-11	-11
1973	452	5451	5835	15648	15583	9171	791	-11	-11	-11	-11	-11
1974	337	2193	3903	9781	4610	2274	1720	105.73	69.34	-11	-11	-11
1975	326	1151	1739	9037	3424	2900	435	68.29	77.88	-11	-11	-11
1976	473	11544	8344	19119	15364	12714	1577	226.29	128.65	-11	-11	-11
1977	433	4378	5054	13924	7041	9540	456	158.38	66.25	-11	-11	-11
1978	446	3252	6922	21681	10778	12084	785	213.62	153.28	-11	-11	-11
1979	662	27835	16425	58049	37468	16106	1146	355.51	197.67	-11	-11	-11
1980	428	4039	2594	19611	11132	8503	308	136.2	131.45	-11	-11	-11
1981	1031	31542	20251	70108	45588	14708	2480	616.99	263.58	-11	-11	-11
1982	594	23987	7615	34884	17459	10413	1584	476.36	148.97	-11	-11	39.488
1983	613	36722	11869	44667	37339	13788	1155	398.7	113.91	-11	185.895	50.377
1984	536	7958	16557	27832	16277	7557	1232	260.99	103.51	105.674	125.847	32.122
1985	1276	47385	56559	93573	62290	33021	13140	721.87	260	634.259	707.449	207.993
1986	549	8818	8523	33426	16213	14429	3709	357.8	188.31	207.673	151.097	56.082
1987	576	21270	12835	36672	34218	14952	3248	473.62	98.16	541.243	337.866	67.359
1988	395	15598	10387	37238	16677	7287	1507	341.71	128.37	397.995	122.127	30.112
1989	386	24198	10235	24903	-11	11148	2257	469.64	121.31	123.152	125.537	20.615
1990	452	9559	-11	57349	-11	13742	988	465.84	136.88	187.159	117.197	36.885
1991	-11	17120	-11	48223	-11	9484	884	497.11	114.16	179.561	164.107	32.24
1992	-11	5398	-11	22184	-11	4866	415	365.17	70.74	124.924	65.199	13.607
1993	-11	9226	-11	18225	-11	2786	-11	263.31	23.06	152.749	47.552	-11
1994	-11	27901	-11	24900	-11	-11	-11	455.58	-11	240.079	-11	-11
1995	-11	13029	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
T-0												
T-1april												
T-1october												
T-2april												
T-2october												
T-3october												
com-0												
com-1												
ISIS-1												
ISIS-2												
ISIS-3												
□□												

Table 3.7.12a North Sea plaice recruitment prediction, 1-year-old.

Analysis by RCT3 ver3.1 of data from file :

g:\acfm\wgnssk96\ple_nsea\pla4rec1.csv

Plaice North Sea - 1-Y-Rcr.,,,,,,,,,,,,

Data for 11 surveys over 29 years : 1967 - 1995

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1990

Survey/ Series Weights	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP
T-0,,, T-1apr	.60	.62	.45	.430	20	9.17	6.09	.516	.043
T-1oct T-2apr	.75	-1.51	.23	.748	21	10.96	6.73	.268	.162
T-2oct	.92	-2.28	.30	.623	22	9.53	6.48	.348	.096
T-3oct	.60	1.83	.45	.429	23	6.90	5.99	.520	.043
com-0	.97	.65	.41	.482	16	6.15	6.64	.470	.052
com-1	1.30	-.08	.35	.562	16	4.93	6.31	.395	.074
ISIS-1	1.02	.62	.72	.311	6	5.24	5.97	.979	.012
ISIS-2	.67	2.80	.21	.810	7	4.77	5.99	.282	.145
ISIS-3	.57	4.14	.14	.894	8	3.63	6.20	.173	.289
					VPA Mean =		6.33	.373	.083

Yearclass = 1991

Survey/ Series Weights	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP
T-0,,, T-1apr	.64	.20	.45	.413	21	9.75	6.43	.517	.045
T-1oct T-2apr	.87	-2.78	.31	.596	22	10.78	6.57	.361	.092
T-2oct	1.01	-3.13	.32	.583	23	9.16	6.08	.370	.087
T-3oct	.59	1.90	.42	.449	24	6.79	5.93	.490	.050
com-0	1.14	-.38	.47	.395	17	6.21	6.69	.546	.040
com-1	1.37	-.48	.35	.539	17	4.75	6.04	.407	.072
ISIS-1	.99	.79	.63	.330	7	5.20	5.95	.817	.018
ISIS-2	.65	2.90	.19	.817	8	5.11	6.23	.240	.207
ISIS-3	.58	4.09	.13	.892	9	3.50	6.11	.165	.299

Table 3.7.12a Continued

						VPA Mean =	6.32	.362	.091

Yearclass = 1992

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series Weights	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP
T-0,,, T-1apr	.70	-.38	.48	.388	21	8.59	5.61	.593	.040
T-1oct T-2apr	.93	-3.41	.32	.584	22	10.01	5.85	.390	.091
T-2oct	1.05	-3.54	.32	.593	23	8.49	5.36	.432	.075
T-3oct	.60	1.84	.42	.451	24	6.03	5.46	.543	.047
com-0	1.26	-1.14	.50	.370	17	5.90	6.30	.578	.042
com-1	1.42	-.73	.36	.528	17	4.27	5.35	.486	.059
ISIS-1	1.00	.78	.63	.329	7	4.84	5.59	.869	.018
ISIS-2	.65	2.90	.19	.816	8	4.19	5.63	.282	.175
ISIS-3	.58	4.09	.13	.893	9	2.68	5.63	.193	.348
						VPA Mean =	6.33	.364	.105

Yearclass = 1993

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series Weights	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP
T-0,,, T-1apr	.76	-1.06	.51	.364	21	9.13	5.92	.615	.077
T-1oct T-2apr	.99	-4.11	.33	.574	22	9.81	5.60	.435	.154
T-2oct T-3oct	1.08	-3.86	.31	.604	23	7.93	4.71	.544	.099
com-0	1.41	-2.07	.53	.348	17	5.58	5.79	.646	.070
com-1	1.48	-1.00	.37	.518	17	3.18	3.69	.842	.041
ISIS-1	1.00	.77	.63	.328	7	5.04	5.78	.851	.040
ISIS-2 ISIS-3	.65	2.90	.20	.815	8	3.88	5.43	.312	.300
						VPA Mean =	6.33	.366	.218

Yearclass = 1994

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series Weights	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP
T-0,,, T-1apr	.84	-1.80	.55	.343	21	10.24	6.78	.669	.121
T-1oct T-2apr	1.05	-4.80	.35	.564	22	10.12	5.85	.435	.286

Table 3.7.12a Continued

T-2oct									
T-3oct									
com-0	1.58	-3.11	.56	.331	17	6.12	6.54	.674	.119
com-1									
ISIS-1	1.00	.76	.64	.326	7	5.49	6.23	.831	.078
ISIS-2									
ISIS-3									
					VPA Mean =		6.33	.369	.396

Yearclass = 1995

Survey/ Series Weights	Slope	Inter-cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP
	I----------Regression----------I					I----------Prediction----------			I
T-0,,,	.91	-2.52	.58	.326	21	9.48	6.10	.711	.215
T-1apr									
T-1oct									
T-2apr									
T-2oct									
T-3oct									
com-0									
com-1									
ISIS-1									
ISIS-2									
ISIS-3									
					VPA Mean =		6.32	.372	.785

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	548	6.31	.11	.08	.61	452	6.12
1991	500	6.21	.11	.06	.34		
1992	300	5.71	.12	.09	.64		
1993	266	5.59	.17	.23	1.78		
1994	525	6.26	.23	.15	.42		
1995	530	6.27	.33	.09	.08		

Table 3.7.12b **North Sea plaice, recruitmenty prediction, 2-year-old.**

Analysis by RCT3 ver3.1 of data from file :

g:\acfm\wgnssk96\ple_nsea\pla4rec2.csv

Plaice North Sea - 2-Y-Recr.,,,,,,,,,,,,

Data for 11 surveys over 29 years : 1967 - 1995

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1990

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.60	.52	.45	.430	20	9.17	5.99	.517	.043
T-1oct T-2apr	.75	-1.62	.23	.749	21	10.96	6.63	.268	.162
T-2oct	.92	-2.39	.30	.624	22	9.53	6.38	.347	.096
T-3oct	.60	1.72	.45	.429	23	6.90	5.89	.521	.043
com-0	.97	.54	.41	.482	16	6.15	6.54	.471	.052
com-1	1.30	-.20	.35	.560	16	4.93	6.21	.397	.074
ISIS-1	1.03	.50	.73	.310	6	5.24	5.87	.984	.012
ISIS-2	.67	2.69	.21	.809	7	4.77	5.89	.284	.144
ISIS-3	.57	4.04	.14	.894	8	3.63	6.10	.173	.290
					VPA Mean =		6.23	.373	.083

Yearclass = 1991

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.64	.09	.45	.413	21	9.75	6.33	.517	.045
T-1oct T-2apr	.87	-2.89	.31	.596	22	10.78	6.47	.361	.092
T-2oct	1.01	-3.24	.32	.584	23	9.16	5.98	.369	.088
T-3oct	.59	1.79	.42	.449	24	6.79	5.83	.490	.050
com-0	1.14	-.49	.47	.395	17	6.21	6.59	.547	.040
com-1	1.38	-.60	.35	.537	17	4.75	5.94	.409	.072
ISIS-1	1.00	.67	.63	.329	7	5.20	5.85	.821	.018
ISIS-2	.65	2.79	.20	.816	8	5.11	6.13	.242	.205
ISIS-3	.58	3.99	.13	.892	9	3.50	6.01	.165	.300
					VPA Mean =		6.22	.363	.091

Yearclass = 1992

Table 3.7.12b Continued

Survey/ Series	Regression Slope	Regression Inter-cept	Regression Std Error	Regression Rsquare	Regression No. Pts	Prediction Index Value	Prediction Predicted Value	Prediction Std Error	Prediction WAP Weights
T-0,,, T-1apr	.70	-.49	.48	.387	21	8.59	5.50	.594	.040
T-1oct T-2apr	.93	-3.53	.32	.584	22	10.01	5.74	.391	.091
T-2oct	1.05	-3.64	.32	.593	23	8.49	5.25	.431	.075
T-3oct	.60	1.73	.42	.451	24	6.03	5.35	.543	.047
com-0	1.26	-1.26	.50	.369	17	5.90	6.20	.580	.042
com-1	1.43	-.86	.36	.526	17	4.27	5.24	.488	.059
ISIS-1	1.00	.66	.63	.328	7	4.84	5.49	.873	.018
ISIS-2	.65	2.79	.20	.815	8	4.19	5.53	.283	.174
ISIS-3	.58	3.98	.13	.893	9	2.68	5.53	.193	.349
					VPA Mean =		6.22	.365	.105

Yearclass = 1993

Survey/ Series	Regression Slope	Regression Inter-cept	Regression Std Error	Regression Rsquare	Regression No. Pts	Prediction Index Value	Prediction Predicted Value	Prediction Std Error	Prediction WAP Weights
T-0,,, T-1apr	.77	-1.18	.52	.363	21	9.13	5.82	.617	.077
T-1oct T-2apr	.99	-4.23	.34	.573	22	9.81	5.49	.436	.155
T-2oct T-3oct	1.08	-3.97	.31	.604	23	7.93	4.61	.544	.099
com-0	1.41	-2.19	.53	.346	17	5.58	5.69	.649	.070
com-1	1.48	-1.13	.38	.516	17	3.18	3.59	.847	.041
ISIS-1	1.00	.65	.64	.326	7	5.04	5.68	.855	.040
ISIS-2 ISIS-3	.65	2.78	.20	.814	8	3.88	5.33	.314	.299
					VPA Mean =		6.23	.367	.219

Yearclass = 1994

Survey/ Series	Regression Slope	Regression Inter-cept	Regression Std Error	Regression Rsquare	Regression No. Pts	Prediction Index Value	Prediction Predicted Value	Prediction Std Error	Prediction WAP Weights
T-0,,, T-1apr	.84	-1.92	.55	.342	21	10.24	6.68	.672	.120
T-1oct T-2apr T-2oct T-3oct	1.05	-4.92	.35	.563	22	10.12	5.75	.436	.286
com-0 com-1	1.58	-3.25	.56	.329	17	6.12	6.44	.677	.118
ISIS-1 ISIS-2 ISIS-3	1.00	.64	.64	.325	7	5.49	6.13	.835	.078
					VPA Mean =		6.23	.370	.398

Table 3.7.12b Continued

Yearclass = 1995

Survey/ Series	Regression: Slope	Regression: Inter-cept	Regression: Std Error	Regression: Rsquare	Regression: No. Pts	Prediction: Index Value	Prediction: Predicted Value	Prediction: Std Error	Prediction: WAP Weights
T-0,,,	.91	-2.65	.58	.325	21	9.48	5.99	.714	.214
T-1apr									
T-1oct									
T-2apr									
T-2oct									
T-3oct									
com-0									
com-1									
ISIS-1									
ISIS-2									
ISIS-3									
					VPA Mean =		6.22	.373	.786

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	495	6.21	.11	.08	.60	409	6.01
1991	451	6.11	.11	.06	.34		
1992	271	5.60	.12	.09	.64		
1993	240	5.48	.17	.23	1.78		
1994	474	6.16	.23	.15	.42		
1995	478	6.17	.33	.09	.08		

Table 3.7.12c

Analysis by RCT3 ver3.1 of data from file :

g:\acfm\wgnssk96\ple_nsea\pla4rec3.csv

Plaice North Sea - 3-Y-Recr.,,,,,,,,,,,,

Data for 11 surveys over 29 years : 1967 - 1995

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1990

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.61	.15	.46	.440	20	9.17	5.76	.524	.042
T-1oct T-2apr	.77	-2.03	.22	.767	21	10.96	6.41	.264	.164
T-2oct	.93	-2.74	.30	.650	22	9.53	6.15	.340	.099
T-3oct	.58	1.70	.40	.507	23	6.90	5.68	.462	.054
com-0	.97	.36	.39	.525	16	6.15	6.30	.448	.057
com-1	1.33	-.56	.35	.579	16	4.93	5.98	.396	.073
ISIS-1	1.01	.37	.70	.341	6	5.24	5.67	.948	.013
ISIS-2	.69	2.38	.22	.813	7	4.77	5.67	.289	.137
ISIS-3	.57	3.81	.11	.935	8	3.63	5.89	.138	.286
					VPA Mean =		6.00	.386	.077

Yearclass = 1991

	I----------Regression----------I					I----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.65	-.27	.46	.419	21	9.75	6.10	.526	.043
T-1oct T-2apr	.87	-3.17	.30	.623	22	10.78	6.25	.351	.095
T-2oct	1.01	-3.48	.31	.617	23	9.16	5.75	.355	.093
T-3oct	.57	1.78	.37	.524	24	6.79	5.62	.434	.062
com-0	1.11	-.57	.44	.439	17	6.21	6.35	.515	.044
com-1	1.39	-.89	.35	.560	17	4.75	5.71	.402	.073
ISIS-1	.99	.52	.61	.360	7	5.20	5.65	.794	.019
ISIS-2	.67	2.48	.20	.818	8	5.11	5.92	.247	.192
ISIS-3	.58	3.76	.11	.931	9	3.50	5.80	.132	.294
					VPA Mean =		5.99	.373	.084

Yearclass = 1992

Table 3.7.12c Continued

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.71	-.88	.49	.389	21	8.59	5.26	.608	.037
T-1oct T-2apr	.93	-3.80	.32	.609	22	10.01	5.52	.381	.094
T-2oct	1.05	-3.85	.30	.627	23	8.49	5.03	.412	.081
T-3oct	.57	1.73	.37	.525	24	6.03	5.17	.480	.059
com-0	1.23	-1.30	.47	.409	17	5.90	5.98	.548	.046
com-1	1.43	-1.10	.36	.552	17	4.27	5.02	.477	.060
ISIS-1	.99	.51	.61	.358	7	4.84	5.29	.846	.019
ISIS-2	.67	2.48	.20	.817	8	4.19	5.30	.291	.162
ISIS-3	.58	3.76	.11	.932	9	2.68	5.32	.155	.343
					VPA Mean =		6.00	.374	.098

Yearclass = 1993

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.79	-1.62	.53	.358	21	9.13	5.58	.638	.072
T-1oct T-2apr	1.00	-4.49	.33	.595	22	9.81	5.27	.427	.162
T-2oct T-3oct	1.08	-4.15	.30	.639	23	7.93	4.39	.518	.110
com-0	1.38	-2.22	.51	.380	17	5.58	5.48	.617	.077
com-1	1.48	-1.33	.36	.544	17	3.18	3.37	.820	.044
ISIS-1	.99	.49	.62	.356	7	5.04	5.48	.829	.043
ISIS-2 ISIS-3	.67	2.47	.20	.815	8	3.88	5.09	.323	.283
					VPA Mean =		6.01	.376	.209

Yearclass = 1994

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
T-0,,, T-1apr	.87	-2.46	.57	.330	21	10.24	6.48	.705	.110
T-1oct T-2apr T-2oct T-3oct	1.06	-5.20	.34	.581	22	10.12	5.53	.429	.296
com-0 com-1	1.55	-3.30	.54	.356	17	6.12	6.22	.652	.128
ISIS-1 ISIS-2 ISIS-3	.99	.48	.62	.354	7	5.49	5.92	.811	.083
					VPA Mean =		6.01	.378	.383

Table 3.7.12c Continued

Yearclass = 1995

Survey/ Series	Regression: Slope	Regression: Inter-cept	Regression: Std Error	Regression: Rsquare	Regression: No. Pts	Prediction: Index Value	Prediction: Predicted Value	Prediction: Std Error	Prediction: WAP Weights
T-0,,,	.96	-3.31	.62	.306	21	9.48	5.77	.761	.200
T-1apr									
T-1oct									
T-2apr									
T-2oct									
T-3oct									
com-0									
com-1									
ISIS-1									
ISIS-2									
ISIS-3									
					VPA Mean =		6.01	.380	.800

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	399	5.99	.11	.08	.61	331	5.81
1991	362	5.89	.11	.06	.35		
1992	216	5.38	.12	.09	.64		
1993	189	5.24	.17	.23	1.83		
1994	379	5.94	.23	.15	.43		
1995	387	5.96	.34	.10	.08		

Table 3.7.13

11:11 Thursday, October 5, 1995

Plaice in the North Sea (Fishing Area IV)

Yield per recruit: Input data

Age	Recruit-ment	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	1.000	0.1000	0.0000	0.0000	0.0000	0.131	0.0077	0.244
2	.	0.1000	0.5000	0.0000	0.0000	0.247	0.1386	0.266
3	.	0.1000	0.5000	0.0000	0.0000	0.268	0.3617	0.289
4	.	0.1000	1.0000	0.0000	0.0000	0.308	0.5134	0.329
5	.	0.1000	1.0000	0.0000	0.0000	0.345	0.6583	0.365
6	.	0.1000	1.0000	0.0000	0.0000	0.407	0.5979	0.430
7	.	0.1000	1.0000	0.0000	0.0000	0.494	0.5040	0.515
8	.	0.1000	1.0000	0.0000	0.0000	0.574	0.3975	0.604
9	.	0.1000	1.0000	0.0000	0.0000	0.663	0.3662	0.697
10	.	0.1000	1.0000	0.0000	0.0000	0.719	0.4330	0.740
11	.	0.1000	1.0000	0.0000	0.0000	0.810	0.4017	0.809
12	.	0.1000	1.0000	0.0000	0.0000	0.904	0.3722	0.887
13	.	0.1000	1.0000	0.0000	0.0000	0.899	0.4369	0.902
14	.	0.1000	1.0000	0.0000	0.0000	0.796	0.4332	0.842
15+	.	0.1000	1.0000	0.0000	0.0000	0.970	0.4332	1.023
Unit	Numbers	-	-	-	-	Kilograms	-	Kilograms

Notes: Run name : P4YR
Date and time: 05OCT95:15:21

Table 3.7.14

11:11 Thursday, October 5, 1995

Plaice in the North Sea (Fishing Area IV)

Yield per recruit: Summary table

						1 January		Spawning time	
F Factor	Reference F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp.stock size	Sp.stock biomass	Sp.stock size	Sp.stock biomass
0.0000	0.0000	0.000	0.000	10.508	6028.170	8.647	5675.561	8.647	5675.561
0.1000	0.0441	0.269	153.053	7.822	3772.118	5.967	3421.189	5.967	3421.189
0.2000	0.0882	0.411	208.617	6.407	2673.469	4.557	2324.196	4.557	2324.196
0.3000	0.1324	0.498	230.339	5.542	2053.605	3.698	1705.967	3.698	1705.967
0.4000	0.1765	0.556	238.601	4.963	1670.239	3.126	1324.211	3.126	1324.211
0.5000	0.2206	0.597	241.161	4.552	1417.255	2.721	1072.816	2.721	1072.816
0.6000	0.2647	0.628	241.274	4.245	1241.812	2.420	898.939	2.420	898.939
0.7000	0.3088	0.652	240.388	4.009	1115.152	2.189	773.824	2.189	773.824
0.8000	0.3529	0.671	239.161	3.821	1020.564	2.007	680.761	2.007	680.761
0.9000	0.3971	0.687	237.891	3.668	947.838	1.859	609.537	1.859	609.537
1.0000	0.4412	0.700	236.708	3.540	890.473	1.738	553.655	1.738	553.655
1.1000	0.4853	0.711	235.659	3.432	844.192	1.635	508.836	1.635	508.836
1.2000	0.5294	0.720	234.754	3.340	806.099	1.548	472.185	1.548	472.185
1.3000	0.5735	0.729	233.984	3.259	774.183	1.473	441.691	1.473	441.691
1.4000	0.6176	0.736	233.336	3.188	747.018	1.407	415.928	1.407	415.928
1.5000	0.6618	0.743	232.792	3.125	723.571	1.349	393.865	1.349	393.865
1.6000	0.7059	0.748	232.338	3.068	703.084	1.297	374.743	1.297	374.743
1.7000	0.7500	0.754	231.959	3.016	684.987	1.251	357.991	1.251	357.991
1.8000	0.7941	0.759	231.643	2.970	668.846	1.209	343.178	1.209	343.178
1.9000	0.8382	0.763	231.379	2.927	654.329	1.171	329.971	1.171	329.971
2.0000	0.8824	0.767	231.158	2.887	641.174	1.136	318.107	1.136	318.107
-	-	Numbers	Grams	Numbers	Grams	Numbers	Grams	Numbers	Grams

Notes: Run name : P4YR004
Date and time : 05OCT95:16:01
Computation of ref. F: Simple mean, age 2 - 10
F-0.1 factor : 0.2296
F-max factor : 0.5539
F-0.1 reference F : 0.1013
F-max reference F : 0.2444
Recruitment : Single recruit

Table 3.7.15

12:33 Friday, October 6, 1995

Plaice in the North Sea (Fishing Area IV)

Prediction with management option table: Input data

Year: 1995								
Age	Stock size	Natural mortality	Maturity ogive	Prop.of F bef.spaw.	Prop.of M bef.spaw.	Weight in stock	Exploit. pattern	Weight in catch
1	525000.00	0.1000	0.0000	0.0000	0.0000	0.131	0.0077	0.244
2	240000.00	0.1000	0.5000	0.0000	0.0000	0.247	0.1386	0.266
3	216000.00	0.1000	0.5000	0.0000	0.0000	0.268	0.3617	0.289
4	203334.00	0.1000	1.0000	0.0000	0.0000	0.308	0.5134	0.329
5	117916.00	0.1000	1.0000	0.0000	0.0000	0.345	0.6583	0.365
6	43862.000	0.1000	1.0000	0.0000	0.0000	0.407	0.5979	0.430
7	21204.000	0.1000	1.0000	0.0000	0.0000	0.494	0.5040	0.515
8	23056.000	0.1000	1.0000	0.0000	0.0000	0.574	0.3975	0.604
9	13646.000	0.1000	1.0000	0.0000	0.0000	0.663	0.3662	0.697
10	16375.000	0.1000	1.0000	0.0000	0.0000	0.719	0.4330	0.740
11	4987.000	0.1000	1.0000	0.0000	0.0000	0.810	0.4017	0.809
12	2336.000	0.1000	1.0000	0.0000	0.0000	0.904	0.3722	0.887
13	1517.000	0.1000	1.0000	0.0000	0.0000	0.899	0.4369	0.902
14	1550.000	0.1000	1.0000	0.0000	0.0000	0.796	0.4332	0.842
15+	2748.000	0.1000	1.0000	0.0000	0.0000	0.970	0.4332	1.023
Unit	Thousands	-	-	-	-	Kilograms	-	Kilograms

Table 3.7.16

12:33 Friday, October 6, 1995

Plaice in the North Sea (Fishing Area IV)

Prediction with management option table

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
1.0000	0.4412	363111	235712	99628	0.0000	0.0000	369903	233874	0	412304	310389
.	.	.	.	.	0.2000	0.0882	.	233874	22292	389528	289245
.	.	.	.	.	0.4000	0.1765	.	233874	42684	368752	270057
.	.	.	.	.	0.6000	0.2647	.	233874	61362	349776	252628
.	.	.	.	.	0.8000	0.3529	.	233874	78490	332424	236782
.	.	.	.	.	1.0000	0.4412	.	233874	94219	316536	222362
.	.	.	.	.	1.2000	0.5294	.	233874	108682	301972	209226
.	.	.	.	.	1.4000	0.6176	.	233874	121998	288604	197249
.	.	.	.	.	1.6000	0.7059	.	233874	134275	276316	186317
.	.	.	.	.	1.8000	0.7941	.	233874	145610	265008	176329
.	.	.	.	.	2.0000	0.8824	.	233874	156089	254586	167192
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

Notes: Run name : P4PRE006
Date and time : 06OCT95:15:40
Computation of ref. F: Simple mean, age 2 - 10
Basis for 1995 : F factors

Table 3.7.17 North Sea plaice: input for catch forecast and linear sensitivity analysis.

Populations in 1995				Stock weights				Nat. Mortality				Proportions maturity		
Label	Value	CV		Label	Value	CV		Label	Value	CV		Label	Value	CV
N1	436864	0.4		WS1	0.135	0.06		M1	0.1	0.1		MT1	0	0.1
N2	229105	0.22		WS2	0.239	0.1		M2	0.1	0.1		MT2	0.5	0.1
N3	213498	0.15		WS3	0.268	0.06		M3	0.1	0.1		MT3	0.5	0.1
N4	203334	0.11		WS4	0.296	0.06		M4	0.1	0.1		MT4	1	0.1
N5	117916	0.1		WS5	0.344	0.03		M5	0.1	0.1		MT5	1	0
N6	43862	0.1		WS6	0.409	0.04		M6	0.1	0.1		MT6	1	0
N7	21203	0.11		WS7	0.5	0.08		M7	0.1	0.1		MT7	1	0
N8	23056	0.1		WS8	0.6	0.07		M8	0.1	0.1		MT8	1	0
N9	13646	0.1		WS9	0.668	0.05		M9	0.1	0.1		MT9	1	0
N10	16374	0.1		WS10	0.732	0.03		M10	0.1	0.1		MT10	1	0
N11	4987	0.1		WS11	0.854	0.11		M11	0.1	0.1		MT11	1	0
N12	2336	0.11		WS12	0.963	0.11		M12	0.1	0.1		MT12	1	0
N13	1517	0.12		WS13	0.929	0.08		M13	0.1	0.1		MT13	1	0
N14	1549	0.13		WS14	0.852	0.15		M14	0.1	0.1		MT14	1	0
N15	2748	0.13		WS15	0.974	0.09		M15	0.1	0.1		MT15	1	0
HC selectivity								Year effect M				HC relative effect		
Label	Value	CV		Label	Value	CV		Label	Value	CV		Label	Value	CV
sH1	0.006	0.43		WH1	0.246	0.07		K95	1	0.1		HF95	1	0.09
sH2	0.136	0.16		WH2	0.274	0.04		K96	1	0.1		HF96	1	0.09
sH3	0.356	0.04		WH3	0.292	0.01		K97	1	0.1		HF97	1	0.09
sH4	0.535	0.1		WH4	0.322	0.04								
sH5	0.683	0.11		WH5	0.366	0.05								
sH6	0.62	0.12		WH6	0.439	0.03		Recruitment						
sH7	0.498	0.06		WH7	0.534	0.07		Label	Value	CV				
sH8	0.396	0.03		WH8	0.632	0.07		R96	436864	0.4				
sH9	0.367	0.1		WH9	0.716	0.04		R97	436864	0.4				
sH10	0.38	0.23		WH10	0.772	0.06								
sH11	0.351	0.25		WH11	0.871	0.11								
sH12	0.336	0.22		WH12	0.931	0.09								
sH13	0.347	0.39		WH13	0.956	0.1								
sH14	0.353	0.35		WH14	0.888	0.08								
sH15	0.353	0.35		WH15	1.029	0.04								

Table 3.7.18 Stock: North Sea plaice

Assessment Quality Control Diagram 1

Average F(2-10,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	0.39	0.44						
1990	0.48	0.60	0.55					
1991	0.48	0.56	0.53	0.56				
1992	0.43	0.44	0.38	0.39	0.46			
1993	0.40	0.42	0.37	0.38	0.47	0.46		
1994	0.44	0.42	0.39	0.37	0.46	0.47	0.46	
1995	0.43	0.40	0.37	0.35	0.43	0.43	0.43	0.44

Remarks:

Assessment Quality Control Diagram 2

Recruitment (age 1) Unit: millions								
Date of assessment	Year class							
	1988	1989	1990	1991	1992	1993	1994	1995
1989	612	750						
1990[1]	574	584	588					
1991[1]	594	617	696	690				
1992[1]	581	598	750	687	567			
1993	404	471	676[1]	699[1]	529[1]	n/a		
1994	381	391	453	476	368	456[1]	-[1]	
1995	395	386	452	457	312	254		

[1]Prediction from recruitment surveys.

Remarks: Predictions for 1994 and 1995 will be updated for ACFM meeting (autumn 1995) based on recuitment survey data currently collected.

Table 3.7.18 Stock: North Sea plaice (Cont'd)

Assessment Quality Control Diagram 3

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	361	385	364[1]	361[1]						
1990	348	382	377	345[1]	326[1]					
1991	341	383	376	355	354[1]	357[1]				
1992	377	433	402	346	385	378[1]	369[1]			
1993	386	429	406	345	325	388	336[1]	329[1]		
1994	373	414	385	325	308	270	257	252[1]	237[1]	
1995	374	419	391	328	328	278	248	235	234[1]	222[1]

[1]Forecast.

Remarks:

Table 3.7.19 North Sea plaice. Commercial catch rate indices.

Year	Belgium beam trawl	UK beam trawl	UK otter trawl	UK seine	Netherlands beam trawl
	1)	kg/hr	kg/hr	kg/hr	kg/hpd
1972	50.8	-	-	-	-
1973	61.8	-	-	-	-
1974	60.9	-	-	-	-
1975	43.4	-	-	-	-
1976	34.3	-	-	-	-
1977	43.8	-	-	-	-
1978	39.8	-	-	-	-
1979	45.4	-	-	-	1.67
1980	50.9	76.7	31.3	23.7	1.73
1981	58.4	81.4	29.5	29.4	1.85
1982	62.9	98.7	32.8	38.2	1.71
1983	70.1	60.4	22.6	37.3	1.44
1984	67.5	52.7	29.7	34.9	1.44
1985	60.8	42.2	25.1	29.0	1.51
1986	55.8	48.6	25.8	34.3	1.65
1987	66.0	59.0	21.1	32.3	1.44
1988	78.0	58.4	22.6	36.0	1.19
1989	74.5	53.2	23.0	43.7	1.38
1990	83.1	49.4	23.0	47.8	1.10
1991	74.6	41.5	15.0	32.0	1.02
1992	60.1	39.4	12.0	28.1	0.74
1993	52.6	33.9	12.3	26.0	0.66
1994	44.8	29.7	7.1	36.0	0.62

1) CPUE index based on hours fishing, corrected for HP.

Table 3.7.20 North Sea PLAICE. Results of trawl surveys in August-September in the southeastern North Sea.

Year	Age-1	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Age-9	Age-10+
NETHERLANDS BTS (8 M BEAM TRAWL)										
1985	105.67	185.90	39.49	13.33	1.50	1.02	0.52	0.16	0.20	0.45
1986	634.26	125.85	50.38	10.18	4.69	0.91	0.48	0.25	0.07	0.24
1987	207.67	707.45	32.12	9.46	2.67	1.54	0.33	0.18	0.10	0.25
1988	541.24	151.10	207.99	6.78	3.05	0.74	0.57	0.13	0.14	0.26
1989	398.00	337.87	56.08	51.10	7.89	1.13	0.42	0.25	0.07	0.32
1990	123.15	122.13	67.36	22.32	10.20	1.13	0.28	0.23	0.07	0.12
1991	187.16	125.54	30.11	21.64	5.36	4.58	0.59	0.17	0.08	0.21
1992	179.56	117.20	20.61	6.10	4.97	2.88	1.41	0.39	0.04	0.09
1993	124.92	164.11	36.88	7.26	1.77	1.54	0.51	0.47	0.15	0.13
1994	152.75	65.20	32.24	10.33	2.08	0.62	0.66	1.34	0.33	0.06
1995	240.08	47.55	13.61	7.45	0.95	0.56	0.35	1.35	0.15	0.11
BELGIUM BTS (8 M BEAM TRAWL 1989-1992, 4 m beam trawl since 1993										
1989	3.6	3.4	6.7	6.7	0.8	0.2	0.1	0.2	-	0.1
1990	2.8	4.8	4.4	5.2	7.5	0.9	0.5	-	-	-
1991	0.5	7.0	3.5	0.8	1.0	0.2	-	-	-	-
1992	8.0	5.0	5.0	3.0	-	1.0	-	-	-	-
1993*	10.8	67.4	1.8	0.2	0.2	-	-	-	-	-
1994*	2.3	2.3	3.1	1.8	0.2	-	-	-	-	-
1995*	1.0	2.2	1.8	2.5	2.5	0.8	0.3	0.3	0.1	0.6

*Values corrected by a factor of 2 in order to standardize from 4 m to 8 m beam length.

Table 3.7.21 Continued

Year class	Coastal surveys					Combined	
	Netherlands/Belgium		Germany	UK			
	0-group	1-group	0-group	0-group	1-group	0-group	1-group
1969	-	2.87	-	-	-	-	-
1970	-	0.93	-	-	-	-	-
1971	4.59	2.63	-	-	-	-	-
1972	2.46	6.79	-	-	-	-	-
1973	2.58	1.96	-	43.48	-	-	-
1974	2.29	3.03	11.3	56.91	14.36	105.73	69.34
1975	2.17	4.03	6.9	21.06	4.76	68.29	77.88
1976	7.03	6.59	28.3	59.87	9.08	226.29	128.65
1977	3.70	3.00	24.7	59.02	11.82	158.38	66.25
1978	8.18	7.91	22.0	31.14	9.75	213.62	153.28
1979	17.07	10.53	17.1	17.67	6.60	355.51	197.67
1980	5.02	6.92	15.3	21.35	5.89	136.20	131.45
1981	28.87	13.83	28.0	53.19	12.64	616.99	263.58
1982	24.01	7.82	14.8	16.74	7.08	476.36	148.97
1983	18.00	5.74	13.3	62.39	9.76	398.70	113.91
1984	10.72	4.65	7.1	70.63	19.14	260.99	103.51
1985	36.98	13.41	6.0	52.61	16.68	721.87	260.00
1986	17.69	9.98	3.6	39.96	7.22	357.80	188.31
1987	23.38	4.97	12.6	33.90	7.98	473.62	98.16
1988	15.50	6.31	12.6	48.67	13.88	341.71	128.37
1989	22.35	6.25	21.2	31.71	7.90	469.64	121.31
1990	22.02	6.88	20.3	34.37	12.04	465.84	136.88
1991	24.47	5.88	20.9	17.80	7.47	497.11	114.16
1992	18.09	3.41	5.4	35.55	8.90	365.17	70.74
1993	12.31	0.87	4.2	42.50	7.30	263.31	23.06
1994	22.92		7.0	35.2		445.50	

Table 3.7.21 North Sea PLAICE recruitment indices.

Year class	1-group VPA	Autumn surveys				Spring survey	
		Tridens O-group	Tridens 1-group	Tridens 2-group	Tridens 3-group	Tridens 1-group	Tridens 2-group
1967	246	-	-	-	2,813	-	-
1968	328	-	-	9,450	1,008	-	7,708
1969	371	-	8,032	23,848	4,484	8,641	-
1970	276	3,678	18,101	9,584	1,631	-	14,840
1971	235	6,708	6,437	4,191	1,261	9,799	8,738
1972	542	9,242	57,238	17,985	10,744	32,980	43,774
1973	452	5,451	15,648	9,171	791	5,835	15,583
1974	337	2,193	9,781	2,274	1,720	3,903	4,610
1975	326	1,151	9,037	2,900	435	1,739	3,424
1976	473	11,544	19,119	12,714	1,577	8,344	15,364
1977	453	4,378	13,924	9,540	456	5,054	7,041
1978	446	3,252	21,681	12,984	785	6,425	10,778
1979	662	27,835	58,049	16,106	1,146	16,567	37,468
1980	428	4,039	19,611	8,503	308	3,694	11,131
1981	1,031	31,542	70,108	14,708	2,480	20,151	45,588
1982	594	23,987	34,884	10,413	1,584	7,615	17,459
1983	613	36,722	44,667	13,788	1,155	11,869	37,339
1984	536	7,958	27,832	7,557	1,232	16,557	16,277
1985	1,276	47,385	93,573	33,021	13,140	56,559	62,290
1986	549	8,818	33,426	14,429	3,709	8,523	16,213
1987	576	21,270	36,672	14,952	3,248	12,835	34,218
1988	395	15,598	37,238	7,287	1,507	10,387	16,677
1989	386	24,198	24,903	11,149	2,257	10,235	-
1990	452	9,559	57,349	13,742	988	-	-
1991	-	17,120	48,223	9,484	884	-	-
1992		5,398	22,184	4,865	415	-	-
1993		9,226	18,225	2,786			
1994		27,901	24,900				
1995		13,029					

Continued

Plaice in the North Sea (Fishing Area IV)
4 – 10 – 1995

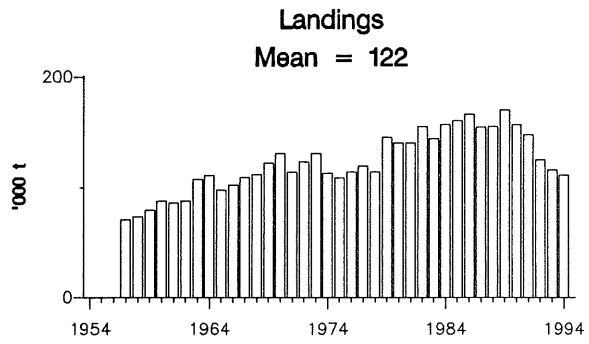


Figure 3.7.1

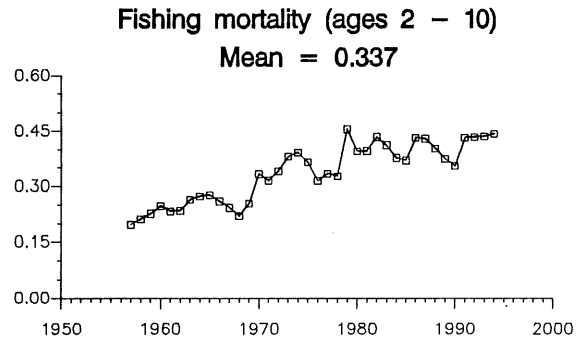


Figure 3.7.2

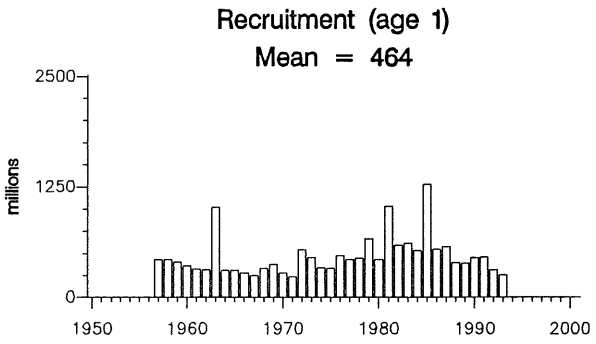


Figure 3.7.3

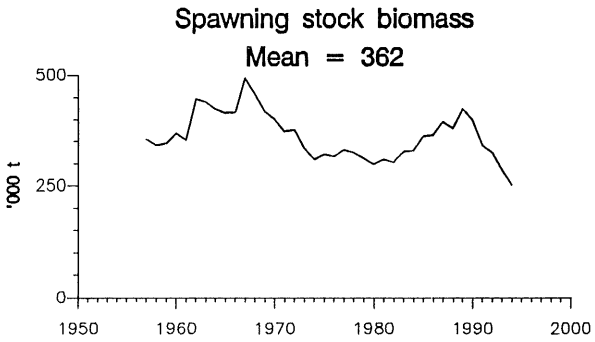
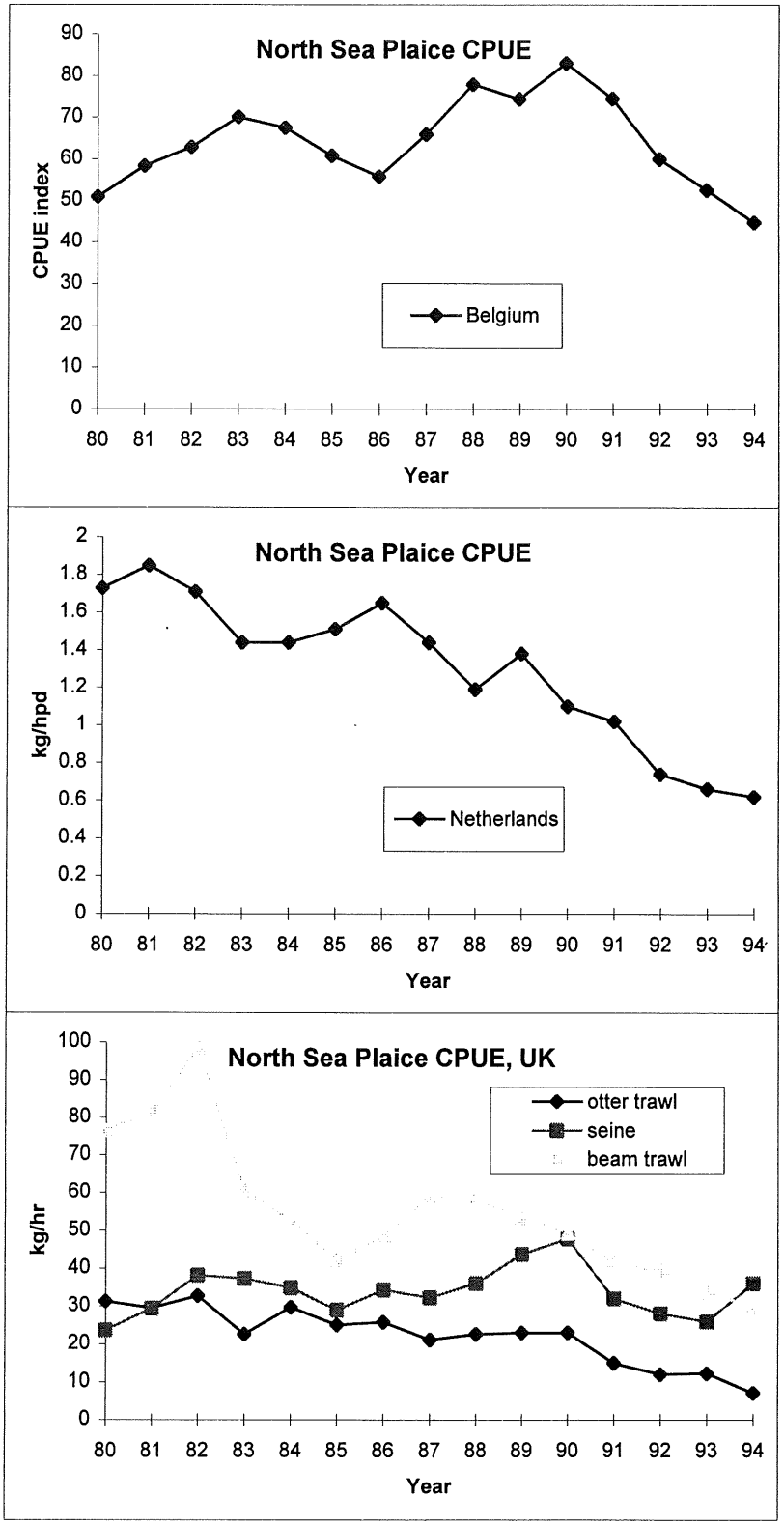


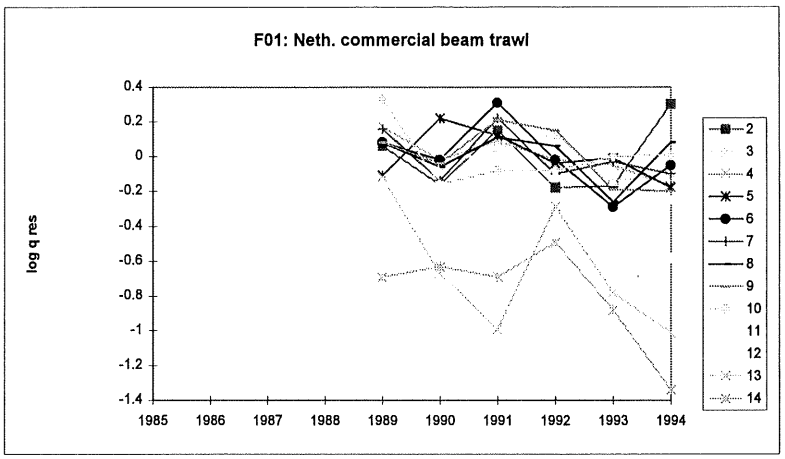
Figure 3.7.4

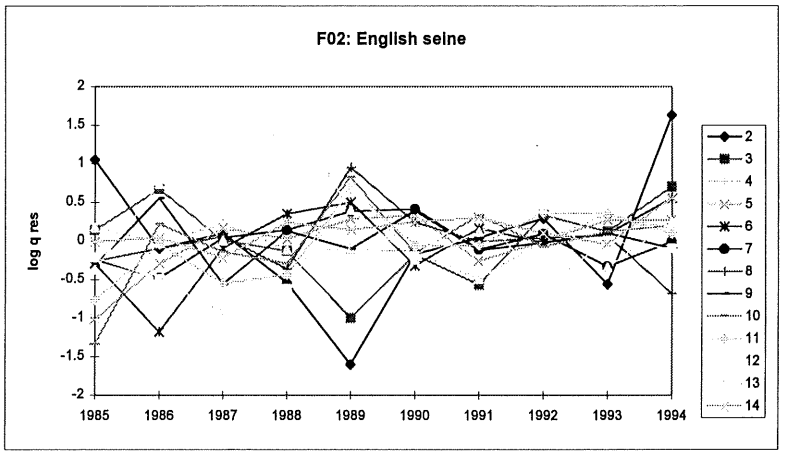
Figure 3.7.5 North Sea plaice: commercial CPUE.

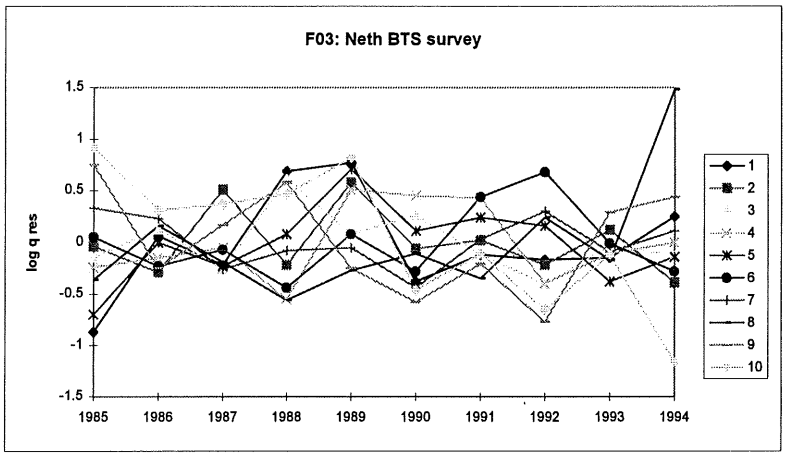


E:\acfm\wgnssk96\ple_nsea\fig375.xls

Figure 3.7.6 Log q residuals.







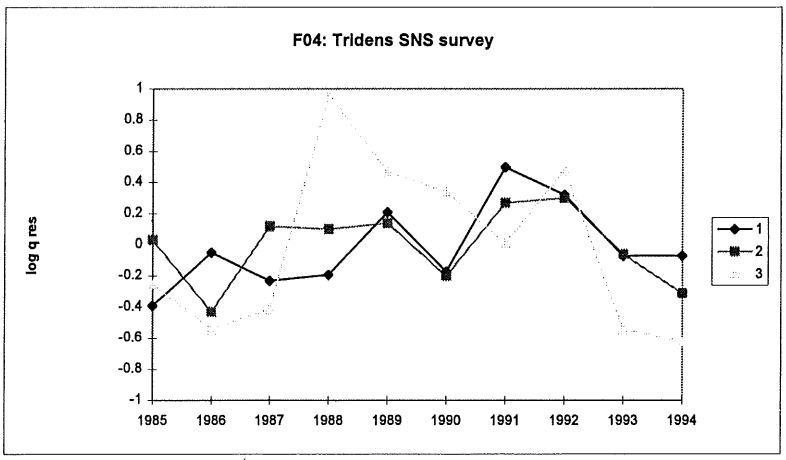
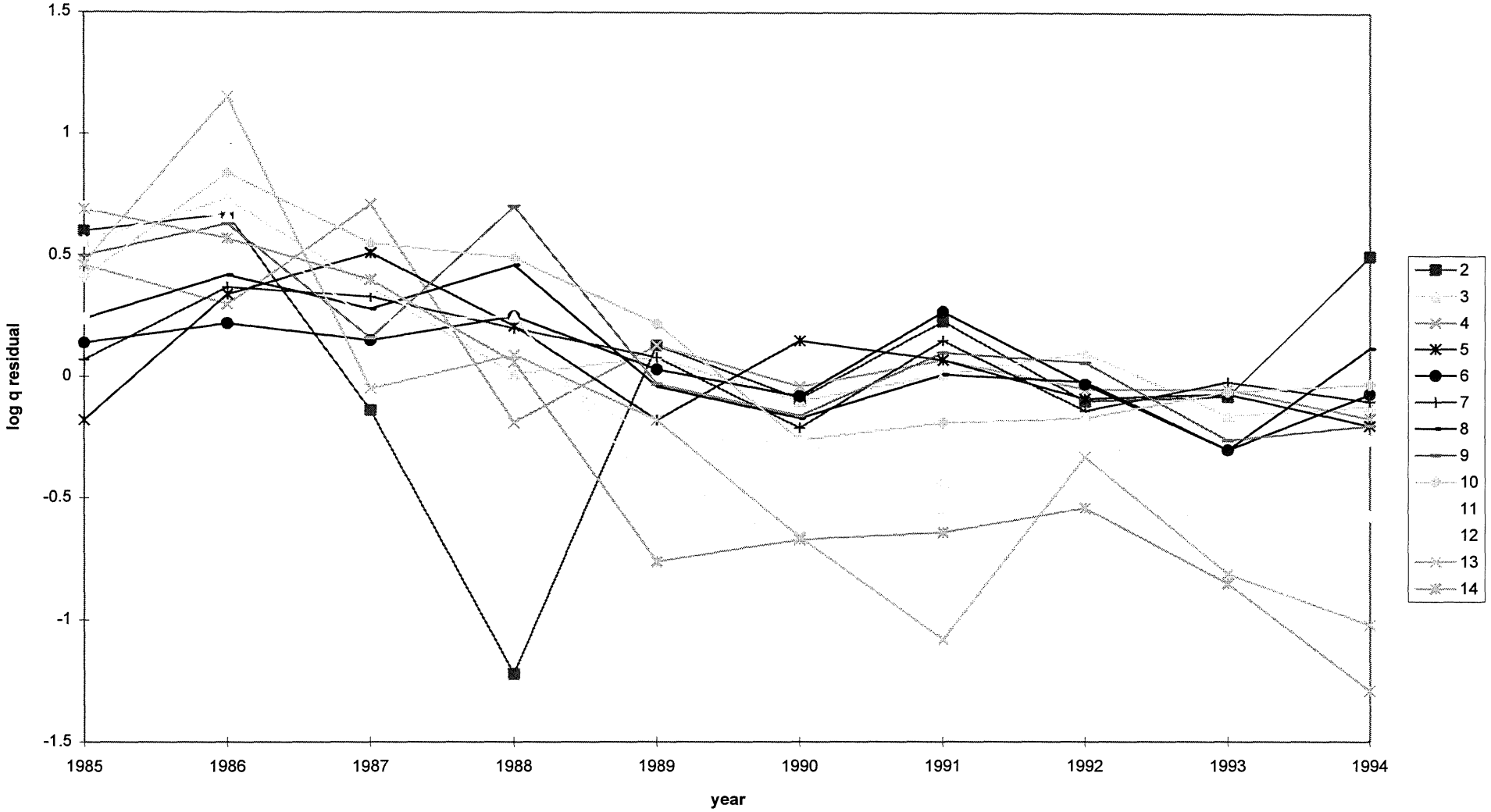


Figure 3.7.6a Log q residuals for Netherlands commercial beam trawl fleet, whole year range.



E:\acfm\wgnssk96\ple_nsea\fig376a.xls

Figure 3.7.7 North Sea plaice. VPA recruitment vs recruitment indices (until year class 1990).

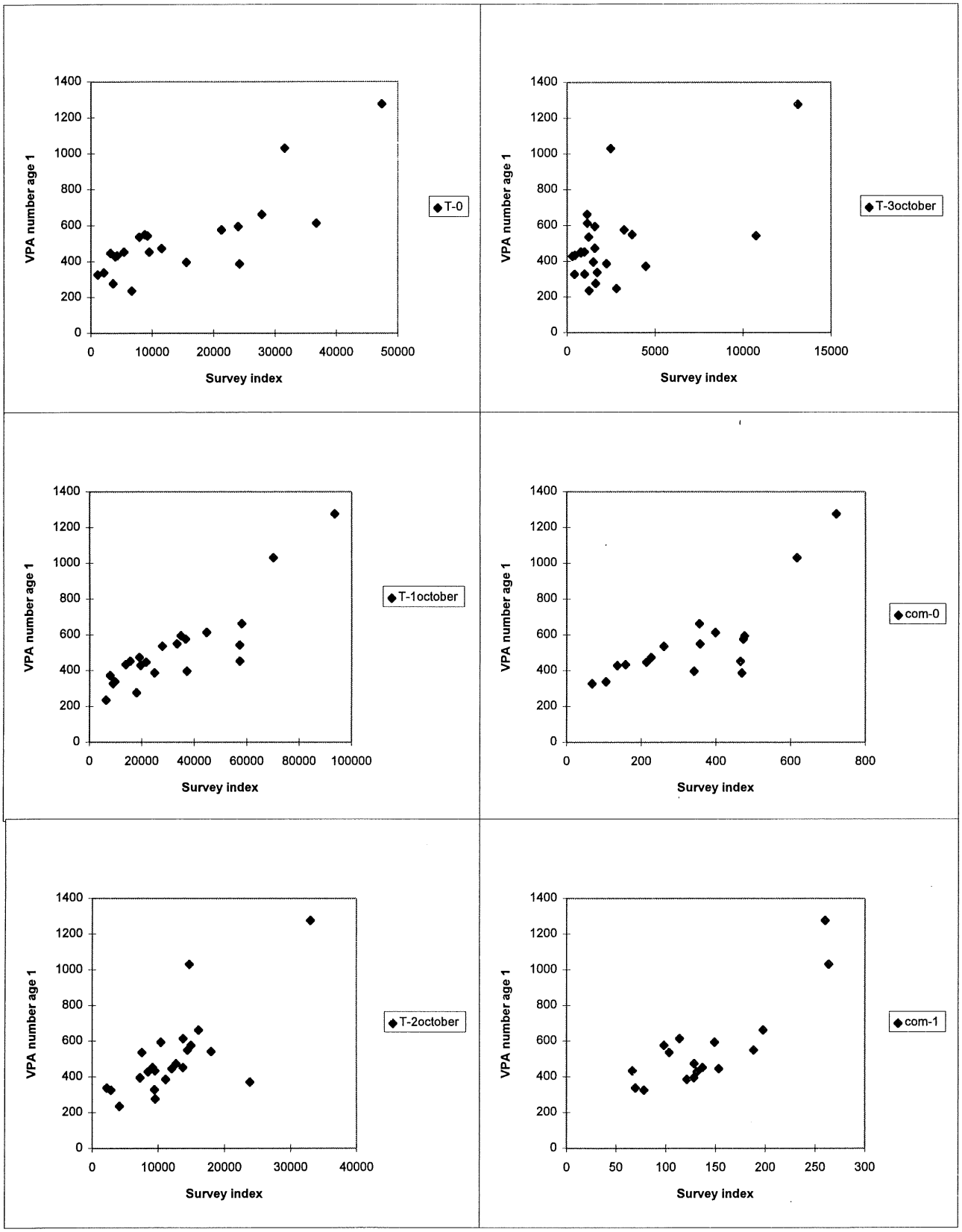
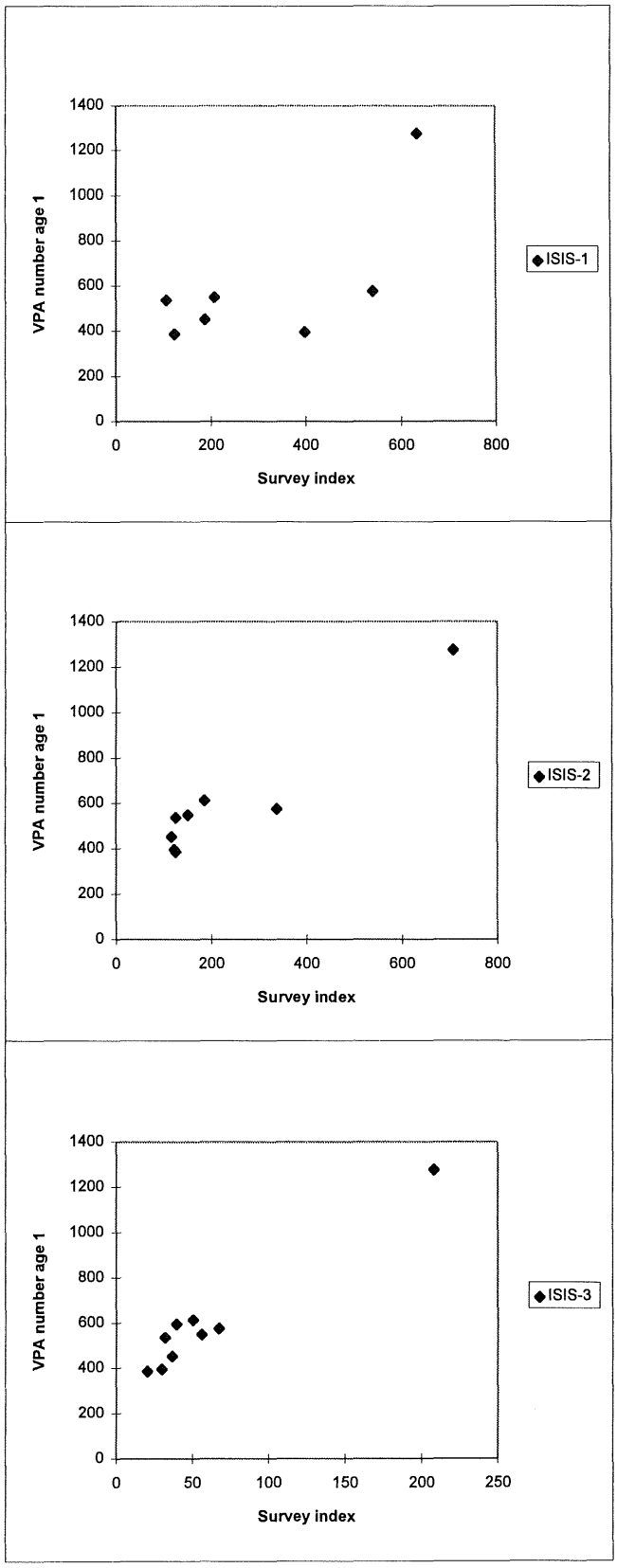
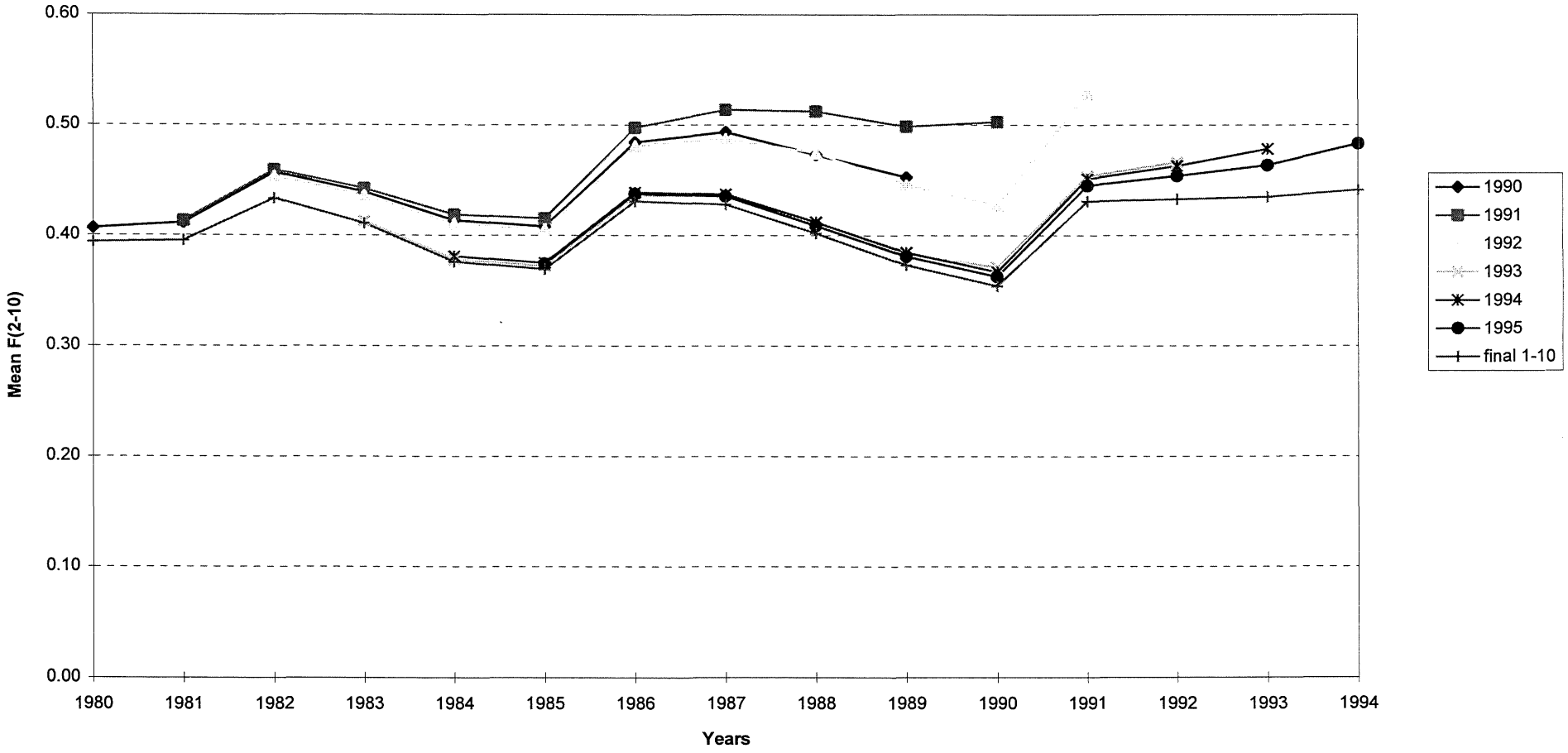


Figure 3.7.7 Continued



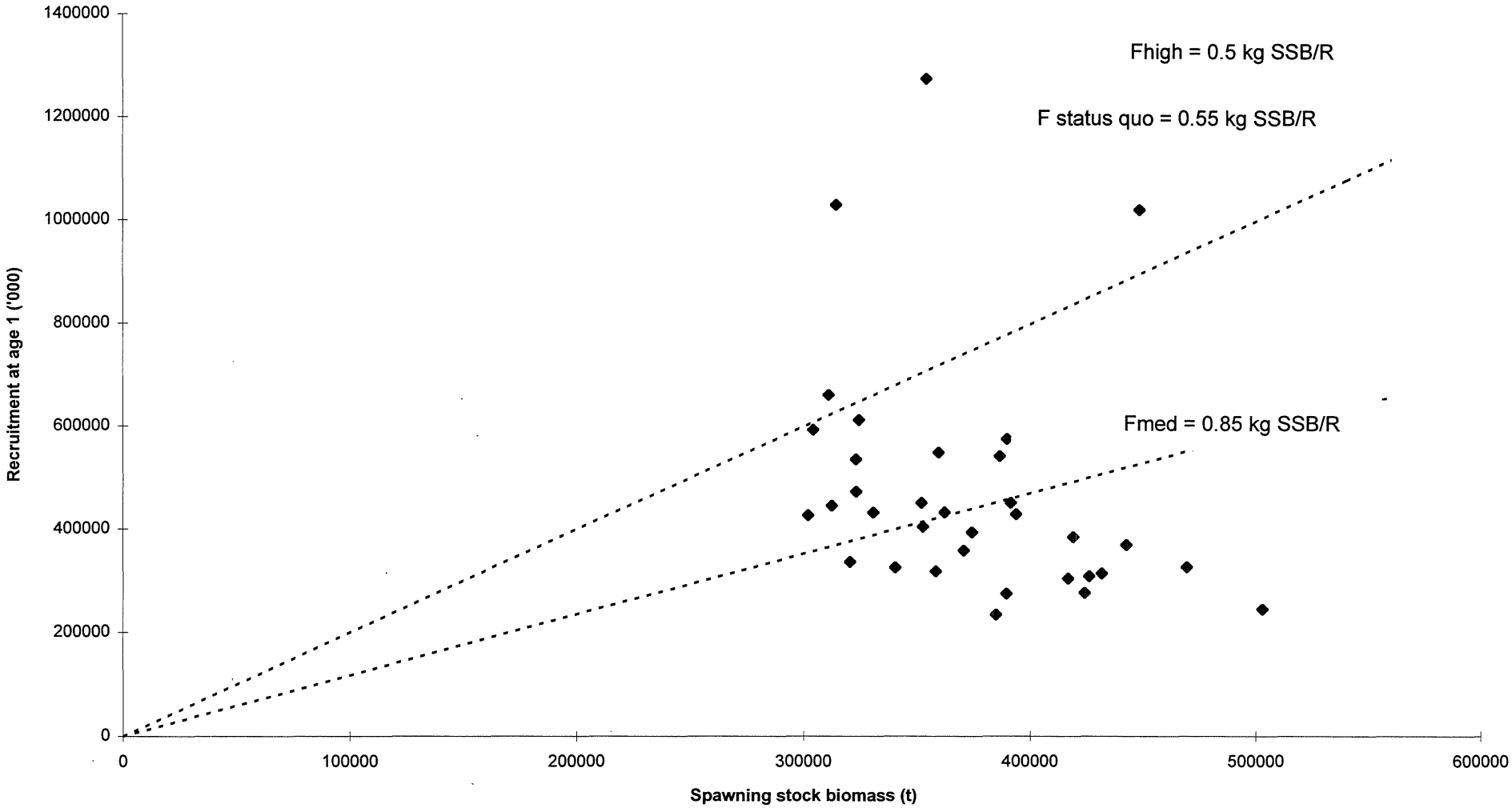
E:\acfm\wgnssk96\ple_nsea\fig377.xls

Figure 3.7.8 North Sea plaice, retrospective analysis.



E:\acfm\wgnssk96\ple_nsea\fig378.xls

Figure 3.7.9 North Sea plaice: stock recruitment plot



E:\acfm\wgnssk96\ple_nsea\fig379.xls

Figure 3.7.11 **North Sea plaice: Sensitivity analysis of short term forecast.**

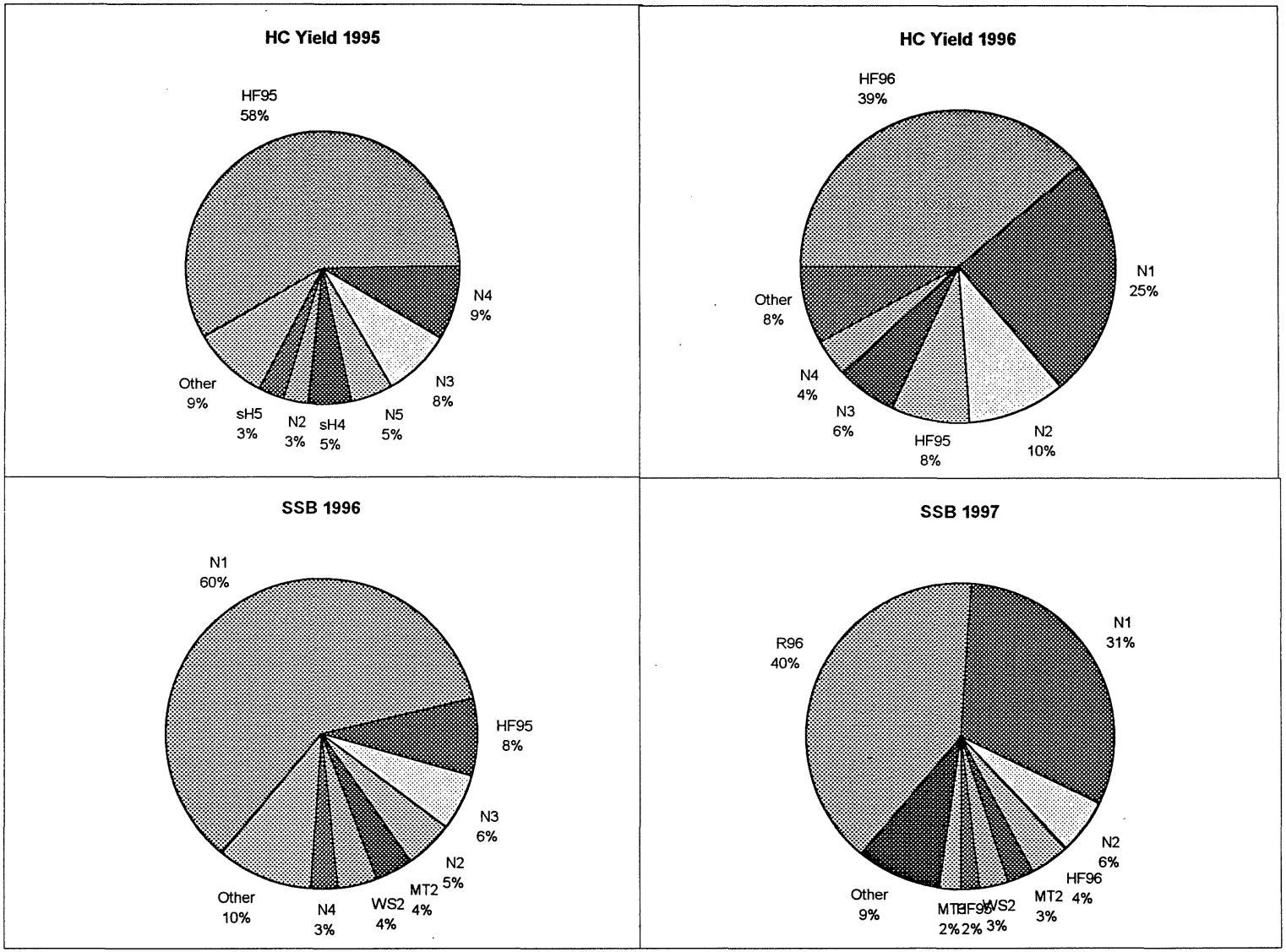
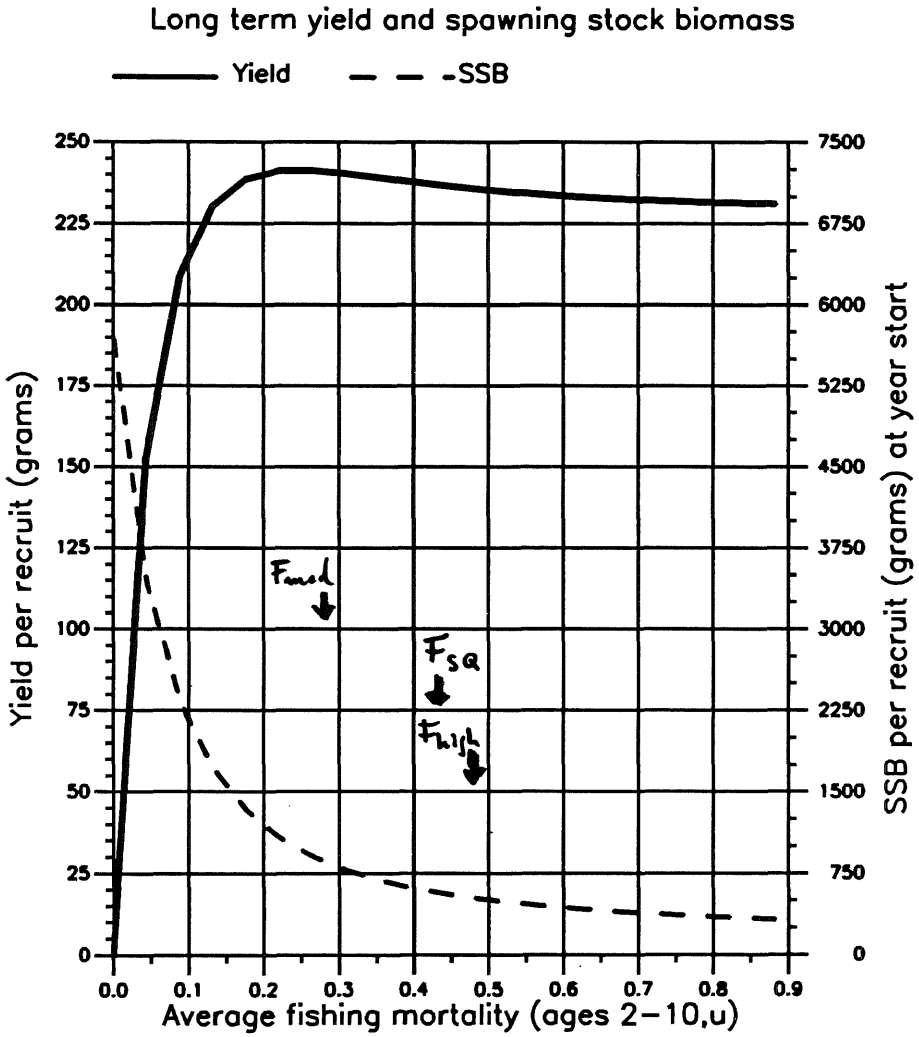


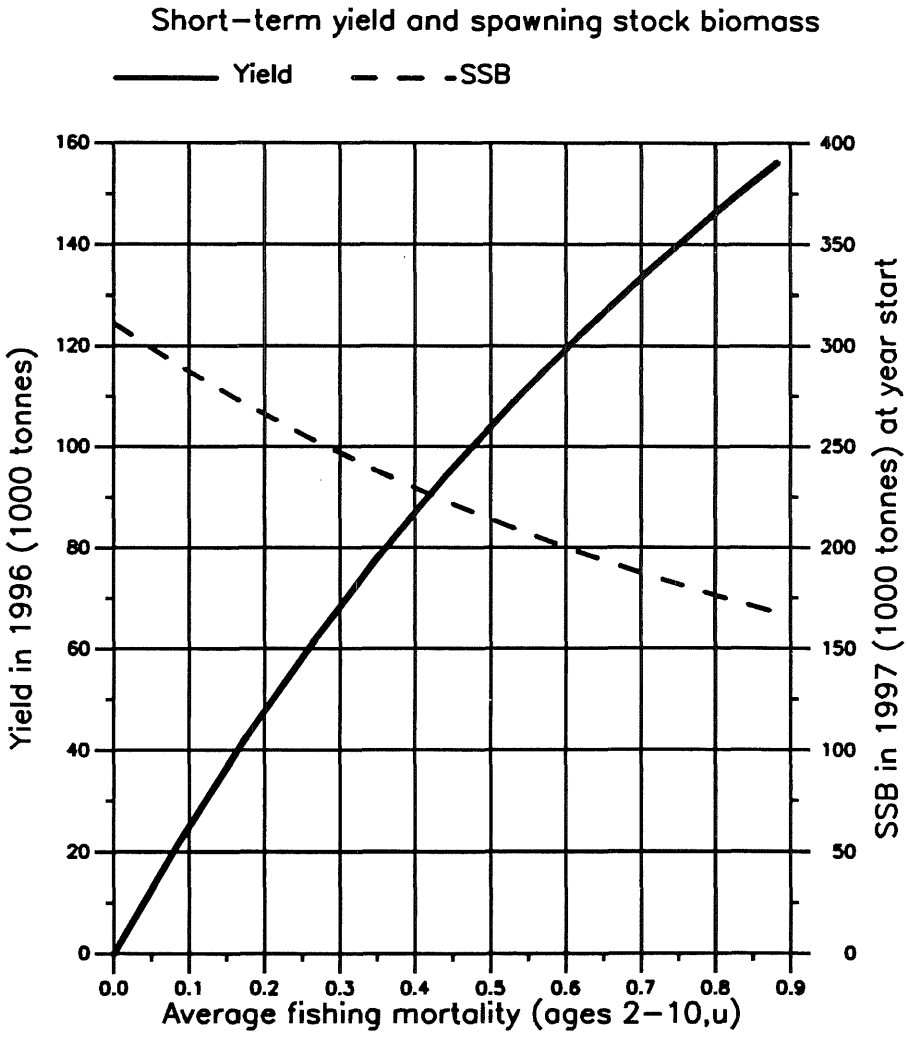
Figure 3.7.10

FISH STOCK SUMMARY
STOCK: Plaice in the North Sea (Fishing Area IV)
6–10–1995



(run: P4YR)

C



(run: P4PRE006)

D

Figure 3.7.12 **North Sea plaice: Linear sensitivity coefficients.**

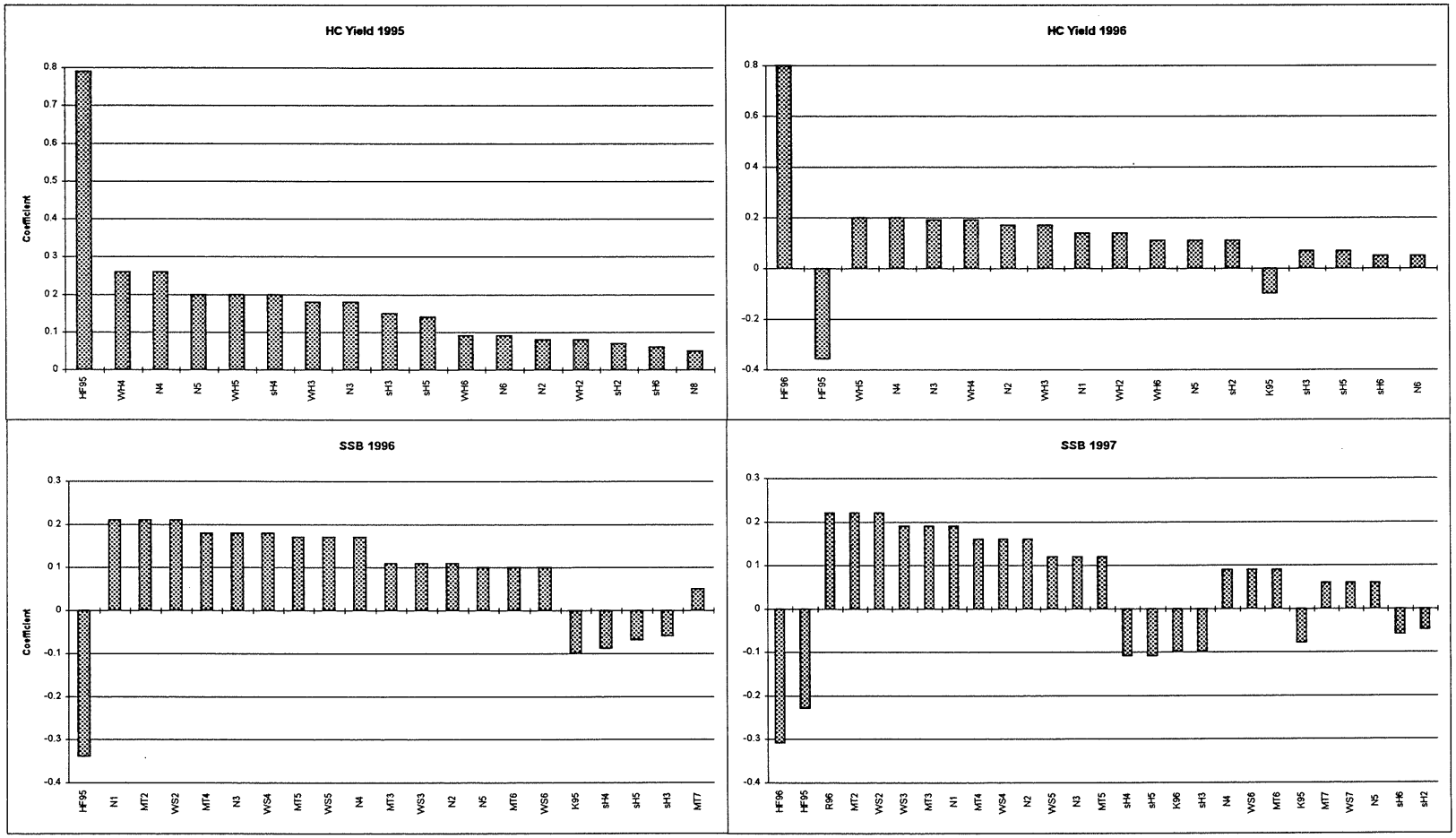
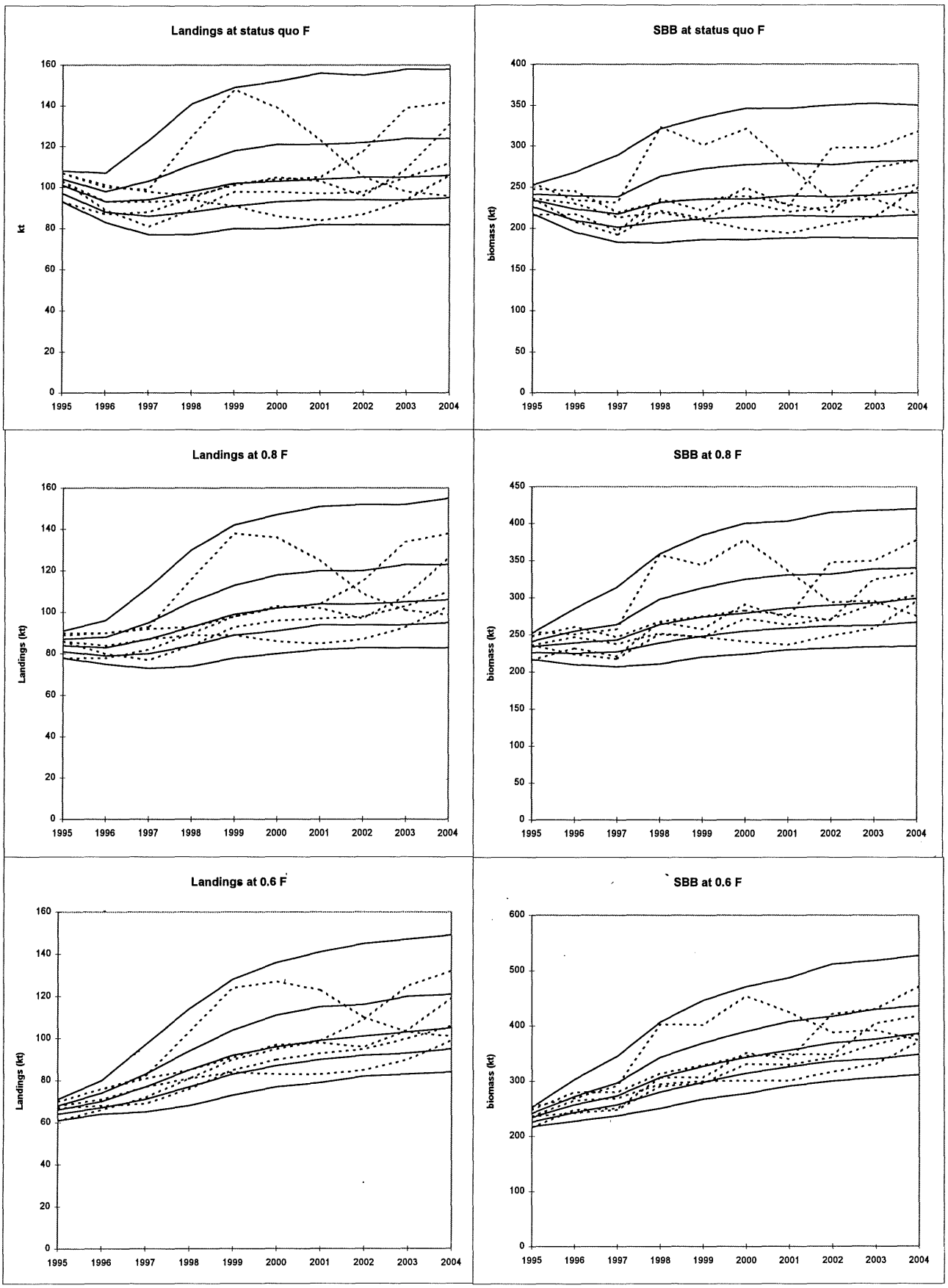
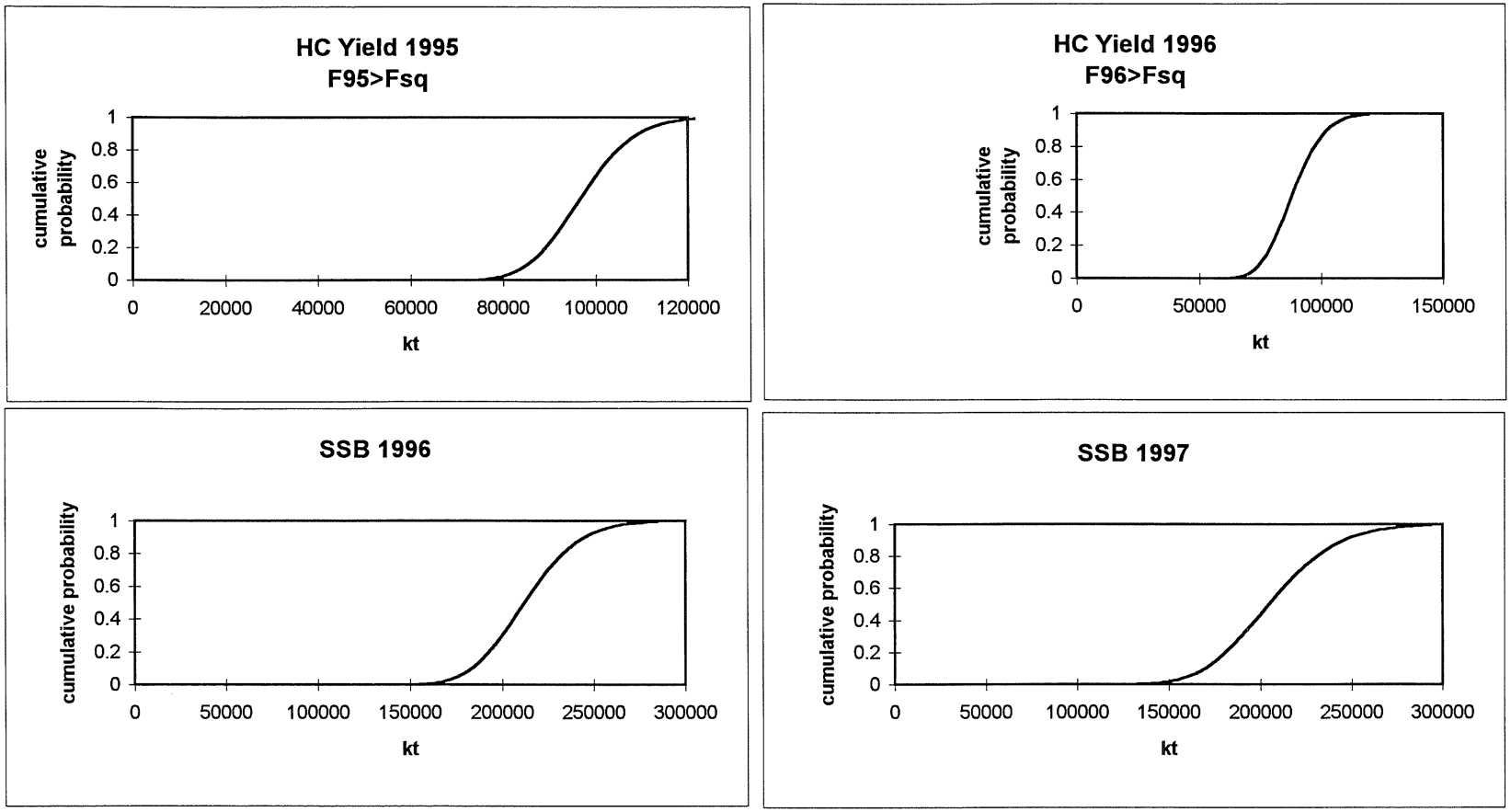


Figure 3.7.13 North Sea plaice. Medium term simulations.



E:\acfm\wgnssk96\ple_nsea\fig3713.xls

Figure 3.7.14 North Sea Plaice: Cumulative probability that Y or SSB fall below a given value



E:\acfm\wgnssk96\F3714.xls

3.8 Norway Pout in Sub-area IV

3.8.1 Catch trends

Annual landings as provided by Working Group members are shown in Table 3.8.1.1 and Figure 3.8.1.1 The total landings in 1994 of 172.000 tonnes is similar to the landings in 1993 and at the same level as the landings since 1986.

The landings by month and country are shown in Table 3.8.1.2. The seasonal distribution of the landings in 1994 are the same as in recent years. The Danish landings decrease in the second quarter of the year, while the Norwegian landings are more evenly distributed over the year.

3.8.2 Natural mortality, maturity, age composition and mean weight at age

Age compositions were available from Norway and Denmark, Table 3.8.2.1. The catches of 0-group fish in the last quarter of 1994 were comparable to those in 1991, suggesting that the 1994 year class is strong. Mean weight at age in the catch were estimated as a weighted average of Danish and Norwegian data, Table 3.8.2.2. There is no weight at age in catch data available for 1990 and these data are modelled in the same way as in previous years. Mean weight at age in the stock, maturity ogive and natural mortality were the same as used in previous years, Table 3.8.2.3

3.8.3 Catch effort and research vessel data

Calculation of the total international effort in the Norway pout fishery

- **Danish data**

1) Information is collected from Danish fishing trips with a share of Norway pout exceeding 50% on the number of fishing days, the GRT of the vessel and the total landings.

2) The data are grouped in 7 GRT classes (5-50, 50-100, 250-300, >300). For each class the following values are calculated by quarter: sum of fishing days, mean catch per fishing day (CPUE).

3) The total number of fishing days in each size class is adjusted to correct for the relative differences in fishing power between the size classes. Therefore the summed fishing days in each class (i) and quarter are multiplied with the yearly $CPUE_i$ of the this particular class divided by the yearly $CPUE_{175}$ of the 150-200 GRT class (midpoint 175 GRT). This standardizes the number of fishing days in each class to the equivalent number of fishing days of a 175 GRT vessel (standardized 175 GRT-fishing days).

- **Norwegian data**

Here the situation is complicated by the fact, that the vessels perform a mixed fishery mainly aiming at Norway Pout. The landing figures of the trips contain mostly Norway pout (NP) but also a variety of other species (among which blue whiting is most important).

1) From the individual trips the following information is recorded: the number of fishing days ($fd_{NP + other}$), the total landings of Norway pout + other ($L_{NP + other}$), the GRT of the vessel and a sample of the catch from which the species composition of the mixed landings is derived. The number of fishing days is not available for years after 1992 and is for these years estimated from a regression relating the number of fishing days with the number of trips, the GRT and the landings. The linear regression applied was of the form:

   fd = 273.7 + 2.437*Trips + 2.258*mean(GRT) + 8.283*Catch(`000 t).

   All variables contributed significantly to the model, while the quarter effect was not significant.

2) The information on the species composition is used to split the total landings into landings of Norway Pout (L_{NP}) and other (L_{other}).

3) From the mixed landings a first estimate of the $CPUE_{NP+other}$ is derived as $L_{NP+other}/fd_{NP+other}$.

4) The total landings of Norway pout (L_{NP}) are divided by the first estimate of the CPUE of the mixed fishery ($CPUE_{NP+other}$) to give the number of fishing days directed at Norway pout (fd_{NP})

   The total number of fishing days directed at Norway pout (fd_{NP}) are also standardized to a vessel size of 175 GRT. From the individual GRT values involved in the Norwegian fishery a mean GRT_{avN} is calculated, weighted by the number of fishing days related to each GRT value. The total number of fishing days is now adjusted to the vessel size 175 GRT. This adjustment is, however based on a regression model, which is derived from data of the *Danish* fishery (this is due to the fact, that only the Danish data are available by size class). The regression model used is a power function of the type $CPUE=a*(GRT-50)^b$. (The function was shifted by 50 GRT on the axis to give a better fit to the data). The adjustment factor is the defined as $((GRT_{avN}-50)/(175-50))^b$, the total number of fishing days multiplied with this factor give the Norwegian standardized 175 GRT-fishing days for Norway pout.

- **Combination of Danish and Norwegian data**

The total standardized 175 GRT-fishing days are the sum of the two national estimates.

More details and the coefficients of the different regression models used can be found in the two previous reports of the then Working Group on the Assessment of Norway Pout and Sandeel (C.M.1994/Assess:7, C.M.1995/Assess:5).

Research vessel data

Survey indices were available from the IBTS, the EGFS (English Ground Fish Survey) and the SGFS (Scottish Ground Fish Survey), Table 3.8.3.3. All surveys indicate a strong 1994 year class.

3.8.4 Catch at age analysis

The SXSA was used to estimate quarterly stock numbers and fishing mortalities (For details concerning the SXSA see appendix 1 in C.M. 1994/Assess:7). Tuning was performed over the period 1983 to 1994 using averaged logged catchabilities and survivor estimates, where the contributions from the various age groups to the survivor estimates were weighted in proportion to the inverse of their variance. The three surveys and the commercial fleet were all used in the tuning. As in previous years the catch at age in 1990 was extrapolated from the estimated catchabilities and stock sizes, under the constraint that the quarterly SOP should be in accordance with observed landings. Table 3.8.4.1 contains the options used as well as the estimated stock numbers, fishing mortalities and additional output from the analysis. The log residual stock numbers are plotted in Figure 3.8.4.3. As expected they are least variable for 1 and 2 year old fish. There is no apparent trend in the residuals with time.

Average fishing mortality for ages 1-2 was at a level of around 1.0 in the early 1980s but then declined to the present level of app. 0.6. The 1991 year class was strong, while the 1992 and 1993 year classes appears to be of intermediate strength. Spawning stock biomass decreased in the mid 1980s, but has since slowly increased again.

The weights in the tuning process in the base run (constant catchability) were reasonably distributed over the different CPUE series with most weight given to the CPUE data from the commercial fishery (CF) and the IYFS of age classes I and II. The 6 most important CPUE series and there respective weights were: CF-age I (weight 2.4), CF-age II (2.0), IYFS-age II (1.8), IYFS-age I (1.5), SGFS-age III (1.5) and SGFS-age I (1.4). The distribution of weights in the run with the cosine filter was very similar.

An alternative run in which a cosine time taper was applied to the catchabilities did not reduce the residuals significantly, even though the estimated catchabilities in this case varied greatly with time, Figure 3.8.4.4. The weights attributed to the loggged catchabilities in the run with the cosine filter was very similar to weights generated in the constant catchability run.

A retrospective analysis was done for both options (Figures 3.8.4.1 and 2). The analysis for the constant catchability option revealed a general tendency to overestimate SSB and recruitment values in the last year. In most cases the estimates converged rapidly, but the estimate of the 1991 year class was gradually revised downward in three successive years to end at approx. 60% of the initial estimate. When the cosine time taper was applied the tendency to overestimate SSB and recruitment was somewhat reduced.

The 1994 assessments have, according to the quality control diagrams (Table 3.8.4.2) to some extent revised the estimates for 1992 and 1993 of last years assessment. The F-values of 1992 and 1993 have increased by 8% and 33% respectively. The decrease in F between 1992 and 1993 was thereby turned into a slight increase. The recruitment estimates (age 1) in 1992 and 1993 were reduced by 14 and 15% respectively. The downward correction of the estimated SSB amounted to 5% in 1992 and 18% in 1993. The previously apparent strong upward trend in SSB between 1992 and 1993 turns out to be less pronounced now and is reversed for 1993 to 1994 into a clear decrease. However, the most recent survey results indicate that a strong year class 1994 is coming into the fishery and this is likely to give an increase in the SSB again.

3.8.5 Recruitment estimates

No further analysis of recruitment.

3.8.6 Historical stock trends

The landings of Norway pout for the period 1957-1994 are presented in Table 3.8.1.1. In addition the estimated average Fishing mortality for 1- and 2-group, the trends in the Spawning Stock Biomass (SSB) and the recruitment trends for the period 1974-1994 are shown in Figure 3.8.1.1.

The pre. 1982 tuning data are not complete for all tuning series and the 1974-1994 trend presented differ slightly from the keyrun (1983-1994), but the conclusions in section 3.8.4 should not be altered.

3.8.7 Biological reference points

A quarterly SSB per recruit analysis and data on stock and recruitment for the period 1974-1993 were used to calculate F_{med} and F_{high}. Values of natural mortality and

proportion mature at age were taken from Table 3.8.2.3. Weight at age in the stock was calculated from the average weight at age in the stock over the period from 1992 to 1994. The average fishing mortality by quarter over the same period was used as representing the present level of fishing mortality. F_{med} was found to be 0.99 (average annual fishing mortality for ages 1 and 2) which is slightly less than two times the present level of average fishing mortality, but which is lower than the fishing mortalities in 1980 and 1984. F_{high} is estimated to be at 3.90, which is 6-7 times the present level of effort. (Figures 3.8.7.1 Recruitment/SSB plot used to calculate F_{med} and F_{high}).

3.8.8 Comments on the assessment

The methodology applied in terms of data preparation and the special features of the assessment programs need to be documented in a more systematic way than it is done so far. Examples are the cosine filter option in the SXSA program, which is not a standard option in 'normal' XSA and the treatment of weight at age data.

In addition the sources of various input parameter values and comments on the considerations why these were chosen should be included in the text. Examples are the M-level, weight at age in the stock, weight at age in the catch, the maturity 0-give etc. As a first step it was tried in this report to summarize the multitude of methods that were used to estimate the international standardized fishing effort. For the present meeting only minor changes have been made to these procedures in order to maintain comparability with the previous work. It is intended, however to revise and standardise the procedures before the next meeting and try to used fleet disaggregated CPUE data instead of a combined effort series in the tuning process.

There is a tendency to overestimate the last year's recruitment in the present assessment, approximately with a factor two. But even allowing for this tendency to overestimation the estimate of the 1994 year class would still be slightly higher than the 1981 year class. The 1981 year class lead to 3 years of high yield in 1982-1984. A precautionary TAC may lead to problems in the fishery when this year class is entering the fishery and the catches in the years 1982-1984 may give some guidance on catch levels to be expected.

3.8.9 Evaluation of usefulness of quarterly International Bottom Trawl Surveys in the assessment

Due to the lack of final ALK's from the quarterly IBTS the WG did not attempt to evaluate the usefulness of quarterly surveys for the assessment of Norway pout.

Table 3.8.1.1 Norway pout annual landings ('000 t) in Sub-area IV, the North Sea, by countries in 1958–1994. (Data provided by Working Group members).

Year	Denmark	Faroes	Norway	Sweden	UK (Scotland)	Others	Total
1957	-	-	0.2	-	-	-	0.2
1958	-	-	-	-	-	-	-
1959	61.5	-	7.8	-	-	-	69.3
1960	17.2	-	13.5	-	-	-	30.7
1961	20.5	-	8.1	-	-	-	28.6
1962	121.8	-	27.9	-	-	-	149.7
1963	67.4	-	70.4	-	-	-	137.8
1964	10.4	-	51.0	-	-	-	61.4
1965	8.2	-	35.0	-	-	-	43.2
1966	35.2	-	17.8	-	-	+	53.0
1967	169.6	-	12.9	-	-	+	182.6
1968	410.8	-	40.9	-	-	+	451.8
1969	52.5	19.6	41.4	-	-	+	113.5
1970	142.1	32.0	63.5	-	0.2	0.2	238.0
1971	178.5	47.2	79.3	-	0.1	0.2	305.3
1972	259.6	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	64.6	108.9	+	17.3	1.7	435.4
1977	232.2	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	19.7	80.8	0.7	5.5	-	270.1
1979	219.9	21.9	75.4	-	3.0	-	320.2
1980	366.2	34.1	70.2	-	0.6	-	471.1
1981	167.5	16.6	51.6	-	+	-	235.7
1982	256.3	15.4	88.0	-	-	-	359.7
1983	301.1	24.5	97.3	-	+	-	422.9
1984	251.9	19.1[1]	83.8	-	0.1	-	354.9
1985	163.7	9.9	22.8	-	0.1	-	196.5
1986	146.3	6.6	21.5	-	-	-	174.4
1987	108.3	4.8	34.1	-	-	-	147.2
1988	79.0	1.5	21.1	-	-	-	101.6
1989	95.6	0.8	65.3	-	0.1	0.3	167.1
1990	61.5	0.9	77.1	-	-	-	139.5
1991	85.0	1.3	68.3	-	-	+	154.6
1992	146.9	2.6	105.5	-	0	0.1	255.1
1993	97.3	n/a	76.7	-	-	-	174.0
1994	97.9	n/a	74.2	-	-	-	Σ 172.1

Table 3.8.1.2 Norway Pout, North Sea. National landings (t) by month, 1992-1994. (Data provided by Working Group members.)

Month	Denmark	Norway	Faroes	Total[1]
1992				
Jan	12,442	8,180		20,622
Feb	13,880	9,362		23,242
Mar	13,337	2,588		15,925
Apr	1,626	3,687		5,313
May	321	7,526		7,847
Jun	1,456	5,175		6,631
Jul	3,228	10,846		14,074
Aug	10,677	13,970		24,647
Sept	36,521	9,977		46,489
Oct	34,605	19,160		53,765
Nov	18,801	10,895		29,696
Dec	31	4,093		4,124
Total	146,925	105,459	2,586	254,970
1993				
Jan	5,678	2,578		8,256
Feb	10,871	7,460		18,331
Mar	6,654	2,558		9,212
Apr	0	4,128		4,128
May	79	12,585		12,664
Jun	1,419	10,171		11,590
Jul	9,646	10,713		20,359
Aug	10,686	7,866		18,552
Sep	12,609	7,358		19,967
Oct	20,741	4,168		24,909
Nov	10,650	3,995		14,645
Dec	8,296	3,092		11,388
Total	97,329	76,672	N/A	174,001
1994				
Jan	8,600	3,425		12,025
Feb	9,579	4,146		13,725
Mar	4,603	3,478		8,101
Apr	681	5,126		5,807
May	0	4,209		4,209
Jun	0	5,340		5,340
Jul	312	9,653		9,965
Aug	4,763	13,524		18,287
Sep	13,697	8,629		22,326
Oct	17,750	8,435		26,185
Nov	21,538	4,706		26,244
Dec	16,335	3,501		19,836
Total	97,858	74,192		172,050

[1]Monthly totals for 1992 estimated assuming Faroes catch is distributed over months as the sum of the Danish and Norwegian landings.

Table 3.8.2.1 NORWAY POUT in the North Sea. Catch in numbers at age by quarter (millions). + represents less than half a million. Data for 1990 only partly available and, therefore not included.

Year	1978				1979				1980			
Age	1	2	3	4	1	2	3	4	1	2	3	4
0	0	0	304	1,225	0	0	968	864	0	0	24	641
1	2,931	1,181	2,385	1,400	5,079	3,270	4,244	2,154	5,044	2,586	7,711	3,920
2	1,371	650	780	322	940	249	763	167	1,075	689	1,960	512
3	93	194	30	6	170	27	49	11	59	29	18	6
4+	4	+	0	0	3	1	0	0	2	5	0	0
Age Year	1981				1982				1983			
0	0	0	77	36,560	0	0	151	1,058	0	0	421	2,520
1	2,223	1,072	1,316	1,038	5,267	3,251	6,576	3,017	3,969	1,723	5,495	4,053
2	1,688	621	944	301	415	275	431	46	1,224	1,165	1,485	358
3	76	77	17	3	216	23	62	0	14	9	16	7
4+	6	2	0	0	0	0	0	0	0	0	1	1
Age Year	1984				1985				1986			
0	0	0	1	2,209	0	0	6	665	0	0	0	5,436
1	2,732	2,230	5,238	3,457	2,220	840	1,373	2,932	395	180	1,186	1,687
2	1,361	1,153	1,666	727	1,337	142	777	171	1,066	60	245	36
3	142	266	8	0	188	13	19	0	72	2	6	0
4+	0	0	0	0	1	0	0	0	3	0	0	0
Age Year	1987				1988				1989			
0	0	0	8	221	0	0	24	2,947	0	0	147	4,585
1	2,665	1,073	1,585	2,138	246	82	183	632	1,711	647	1,653	1,719
2	398	60	165	230	699	71	250	405	48	133	207	90
3	12	0	0	5	20	0	0	0	6	6	0	13
4+	1	0	0	0	0	0	0	0	0	0	0	0
Age Year	1990				1991				1992			
0					0	0	76	2,607	0	0	34	456
1					1,485	419	1,010	1,030	3,340	997	2,608	2,643
2					1,335	397	67	185	1067	230	372	254
3					93	19	1	17	117	20	1	2
4+					6	0	0	0	3	0	0	0
Age Year	1993				1994							
0			11	929			186	3,794				
1	1,925	754	1,040	1,033	1,902	372	1,029	1,148				
2	692	472	889	442	589	285	402	134				
3	14	58	19	2	56	29	71					
4+	-	0	0	0								

Table 3.8.2.2 Norway pout. North Sea 1986-1994. Mean weight at age by quarter. Danish and Norwegian catches combined (grams).

		Age Group				
Year	Quarter	0	1	2	3	4
1986	1	-	6.69	29.74	44.08	82.51
	2	-	14.49	42.92	55.39	-
	3	-	28.81	43.39	47.60	-
	4	7.20	26.90	44.00	-	-
1987	1	-	8.13	28.26	52.93	63.09
	2	-	12.59	31.51	-	-
	3	5.80	20.16	34.53	-	-
	4	7.40	23.36	37.32	46.60	-
1988	1	-	9.23	27.31	38.38	69.48
	2	-	11.61	33.26	-	-
	3	9.42	26.54	39.82	-	-
	4	7.91	30.60	43.31	-	-
1989	1	-	7.98	26.74	39.95	-
	2	-	13.49	28.70	44.39	-
	3	7.48	26.58	35.44	-	-
	4	6.69	26.76	34.70	46.50	-
1990	1	-	6.51	25.47	37.72	68.00
	2	-	13.75	25.30	40.35	-
	3	6.40	20.29	32.92	39.40	-
	4[1]	6.67	21.7	38.9	52.94	-
1991	1	-	7.85	20.54	35.43	44.3
	2	-	12.95	28.75	49.87	-
	3	6.06	30.95	44.28	67.25	-
	4	6.64	30.65	43.10	59.37	-
1992	1	-	8.12	25.73	41.80	43.9
	2	8.00	11.31	31.25	49.49	-
	3	6.70	26.52	42.42	50.00	-
	4	8.14	27.49	44.14	50.30	-
1993	1	-	9.32	24.94	46.50	-
	2	-	14.76	30.58	48.73	-
	3	4.40	25.03	35.19	55.40	-
	4	8.14	26.24	36.44	70.80	-
1994	1		8.56	25.91	42.09	
	2		15.22	29.27	46.88	
	3	5.40	29.26	38.91	53.95	
	4	7.81	31.23	49.59		

[1]Mean of 1989 and 1991 values.

Table 3.8.2.3 Norway pout. Mean weight at age in the stock, proportion mature and natural mortality.

Age	w(g)				Matprop	M (per quarter)
	Q1	Q2	Q3	Q4		
0	-	-	4	6	0	0.4
1	7.0	15.0	25.0	23.0	0.1	0.4
2	22.0	34.0	43.0	42.0	1.0	0.4
3	40.0	50.0	60.0	58.0	1.0	0.4
4	56.0	56.0	-	-	1.0	0.4

Table 3.8.3.1.a Norway pout. Danish CPUE data (tonnes/day fishing) by vessel category for 1983-1994.

Vessel GRT	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
51-100	11.37	12.53	11.60	10.83	11.73	20.26	14.64	9.68	12.56	-	-	-
101-150	24.51	21.35	17.98	19.49	20.70	19.83	19.93	18.21	24.14	26.43	23.72	26.45
151-200	29.00	24.17	20.76	22.97	22.20	23.91	24.06	25.62	28.22	34.20	27.36	31.43
201-250	32.71	27.82	24.80	25.20	27.51	30.50	27.43	25.34	29.45	37.50	28.44	40.70
251-300	32.05	26.59	22.86	25.12	25.58	24.03	26.10	21.87	28.15	31.90	32.05	37.94
301-	31.81	37.47	26.86	26.63	31.10	40.09	28.92	25.91	36.73	41.84	35.10	46.09

Table 3.8.3.1.b Days fishing and average GRT of Norwegian vessels fishing for Norway pout by quarter, 1982-1992.

		q1	q2	q3	q4
1982	Effort	528	1578	1043	616
	Ave GRT	178.8	142.0	178.0	187.1
1983	Effort	293	1168	2039	552
	Ave GRT	167.6	168.4	159.9	171.7
1984	Effort	509	1442	1576	315
	Ave GRT	178.5	141.6	161.2	212.4
1985	Effort	363	417	230	250
	Ave GRT	166.9	169.1	202.8	221.4
1986	Effort	429	598	195	222
	Ave GRT	184.3	148.2	197.4	226.0
1987	Effort	412	555	208	334
	Ave GRT	199.3	170.5	158.4	196.3
1988	Effort	296	152	73	590
	Ave GRT	216.4	146.5	191.1	202.9
1989	Effort	132	586	1054	1687
	Ave GRT	228.5	113.7	192.1	178.7
1990	Effort	369	2022	1102	1143
	Ave GRT	211.0	171.7	193.9	187.6
1991	Effort	774	820	1013	836
	Ave GRT	196.1	180.0	179.4	187.7
1992	Effort	847	352	1030	1133
	Ave GRT	206.3	181.3	202.2	199.8
1993	Effort	640	1098	1150	682
	Ave GRT	207.4	183.0	196.3	198.5
1994	Effort	533	600	1230	641
	Ave Grt	206.5	198.0	191.0	190.9

Table 3.8.3.2 Combined Danish and Norwegian fishing effort on Norway pout.

		q1	q2	q3	q4	
1982	Norway	534	1404	1052	638	3629
	Denmark	1922	502	3929	2234	8587
	Total	2456	1906	4981	2872	12216
1983	Norway	286	1144	1942	546	3919
	Denmark	2318	505	3725	3620	10168
	Total	2604	1649	5667	4166	14087
1984	Norway	514	1015	1507	348	3385
	Denmark	1887	454	3783	4433	10557
	Total	2401	1469	5290	4781	13942
1985	Norway	354	409	248	282	1293
	Denmark	2177	232	2044	3340	7793
	Total	2531	641	2292	3622	9086
1986	Norway	441	546	208	253	1447
	Denmark	3198	126	2025	5835	11184
	Total	3639	672	2233	6088	12631
1987	Norway	441	547	197	355	1539
	Denmark	1169	7	1333	1946	4455
	Total	1610	554	1530	2301	5994
1988	Norway	330	138	76	637	1181
	Denmark	910	3	464	1957	3334
	Total	1240	141	540	2594	4515
1989	Norway	148	471	1099	1703	3421
	Denmark	565	76	1323	2009	3973
	Total	713	547	2422	3712	7394
1990	Norway	401	2005	1153	1179	4738
	Denmark	574	616	446	1167	2803
	Total	975	2621	1599	2346	7541
1991	Norway	814	830	1024	863	3532
	Denmark	979	18	517	1524	3038
	Total	1793	848	1541	2387	6570
1992	Norway	911	358	1098	1201	3568
	Denmark	1682	101	1213	1264	4260
	Total	2593	459	2311	2465	7828
1993	Norway	690	1120	1210	721	3741
	Denmark	1210	35	1527	1650	4422
	Total	1900	1155	2737	2371	8163
1994	Norway	573	634	1279	666	3152
	Denmark	1106	27	452	1283	2868
	Total	1679	661	1731	1949	6021

Table 3.8.3.3 Research vessel indices for NORWAY UT.

Year Class	IYFS[1] February			EGFS[2] August				SGFS[3] August			
	1-group	2-group	3-group	0-group	1-group	2-group	3-group	0-group	1-group	2-group	3-group
1968	-	6	-	-	-	-	-	-	-	-	-
1969	35	22	-	-	-	-	-	-	-	-	-
1970	1,556	653	-	-	-	-	-	-	-	-	-
1971	3,425	438	-	-	-	-	-	-	-	-	-
1972	4,207	399	-	-	-	-	-	-	-	-	-
1973	25,626	2,412	-	-	-	-	-	-	-	-	-
1974	4,242	385	-	-	-	-	25		-	-	-
1975	4,599	334	-	-	-	239	25		-	-	-
1976	4,813	1,215	-	-	770	119	-		-	-	-
1977	1,913	240	-	1,388	314	20	7		-	-	12.0
1978	2,690	611	-	1,209	600	60	25		-	346.0	9.0
1979	4,081	557	-	1,599	824	283	11		1,928.0	127.0	22.0
1980	1,375	403	9	151	385	13	1		185.0	43.9	1.0
1981	3,315	663	58	1,770	712	29	3		991.3	90.8	8.5
1982	2,331	802	71	1,818	517	93	2	8.0	489.5	68.8	5.4
1983	3,925	1,423	23	1,501	1,008	74	18	13.3	615.1	173.1	8.9
1984	2,109	384	65	160	300	47	-	1.9	635.7	53.8	1.1
1985	2,043	469	13	136	219	41	3	4.7	388.7	22.6	4.4
1986	3,023	760	178	109	152	34	5	38.4	337.9	209.2	14.3
1987	127	260	46	2	26	153	9	7.4	38.2	21.4	1.5
1988	2,079	773	129	45	350	45	2	13.7	381.7	51.0	6.2
1989	1,320	677	33	400	264	118	48[5]	1.5	206.2	42.3	24.0
1990	2,497	902	259	627	161	324[5]	34[4,5]	57.9	731.7	221.3	20.4
1991	5,121	2,644	67	401	1,877[5]	520[5]	-	9.7	1,714.6	329.1	5.8
1992	2,681	375	77	874[5]	993[5]	34[4]	4[5]	12.2	580.4	106.3	20.8
1993	1,868	785		1,727[5]	395[5]	117[5]		1.7	387.2	233,5	
1994	5,941			2,353[5]	1,871[5]			136.0	2,438,2		
1995								36.2			

[1]International Bottom Trawl Survey, arithmetic mean catch in no./h in standard area.
[2]English groundfish survey, arithmetic mean catch in no./h, 22 selected rectangles within Roundfish areas 1, 2, and 3.
[3]Scottish groundfish surveys, arithmetic mean catch no./h.
[4]Preliminary.
[5]GOV adjusted to Granton trawl by dividing by 3.3.

Table 3.8.4.1 Survivors analysis results (keyrun table 1983-1994)

SURVIVORS ANALYSIS OF:

Norway pout in the North Sea

The following parameters were used:

Year range: **1983 - 1994**
Seasons per year: 4
The last season in the last year is season : 4
Youngest age: 0; Oldest age: 3; (Plus age: 4)
Recruitment in season: 3
Spawning in season: 1

The following fleets were included:
Fleet 1: Commercial fishery
Fleet 2: IYFS
Fleet 3: EGFS
Fleet 4: SGFS

The following options were used:

1: Inv. catchability: 2
(1: Linear; 2: Log; 3: Cos. filter)
2: Indiv. shats: 2
(1: Direct; 2: Using z)
3: Comb. shats: 2
(1: Linear; 2: Log.)
4: Fit catches: 0
(0: No fit; 1: No SOP corr; 2: SOP corr.)
5: Est. unknown catches: 2
(0: No; 1: No SOP corr; 2: SOP corr; 3: Sep. F)
6: Weighting of rhats: 0
(0: Manual)
7: Weighting of shats: 2
(0: Manual; 1: Linear; 2: Log.)
8: Handling of the plus group: 1
(1: Dynamic; 2: Extra age group)

Data were input from the following files:
Catch in numbers: **canum.qrt**
Weight in catch: **weca.qrt**
Weight in stock: **west.qrt**
Natural mortalities: **natmor.qrt**
Maturity ogive: **matprop.qrt**
Tuning data (CPUE): **tuning.xsa**
Weighting for rhats: **rweigh.xsa**
Unknown catches: uc90

Stock numbers (at start of season)

****

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	152959.	102186.	*	*	79411.	53230.	*	*	56806.	38073.
1	106080.	67858.	44076.	25046.	66434.	42296.	26526.	13492.	33873.	20888.	13314.	7800.
2	13159.	7819.	4287.	1658.	13470.	7915.	4362.	1560.	6214.	3071.	1942.	666.
3	112.	64.	35.	11.	818.	432.	72.	42.	450.	148.	89.	44.
4+	6.	2.	0.	0.	1.	1.	1.	0.	28.	18.	12.	8.
SSN	23885.				20934.				10080.			
SSB	368584.				375663.				180008.			
TSN	119357.	75743.	201357.	128901.	80725.	50644.	110371.	68324.	40565.	24125.	72163.	46591.
TSB	1036887.	1287027.	1900201.	1259427.	794200.	925217.	1172664.	697631.	393405.	426143.	648888.	438345.

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	114524.	76768.	*	*	31892.	21371.	*	*	89845.	60206.
1	24977.	16419.	10859.	6308.	47008.	29329.	18781.	11292.	14145.	9280.	6154.	3975.
2	2828.	1023.	637.	226.	2847.	1583.	1012.	543.	5819.	3328.	2173.	1251.
3	306.	146.	96.	60.	122.	72.	48.	32.	176.	102.	68.	46.
4+	35.	21.	14.	9.	46.	30.	20.	14.	27.	18.	12.	8.

Table 3.8.4.1 Continued

SSN	5667.				7716.				7436.			
SSB	93905.				103020.				146435.			
TSN	28146.	17609.	126130.	83371.	50024.	31014.	51754.	33252.	20166.	12728.	98252.	65486.
TSB	251260.	289557.	762724.	618648.	399173.	499033.	643498.	412624.	235547.	258461.	610739.	507866.

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	99546.	66722.	*	*	95421.	63952.	*	*	164181.	109992.
1	37944.	24029.	15539.	9518.	40860.	26033.	15992.	9961.	42061.	26979.	17741.	11065.
2	2147.	1400.	819.	387.	4788.	2703.	1348.	731.	5719.	2741.	1512.	959.
3	507.	334.	219.	147.	186.	105.	52.	28.	388.	184.	108.	71.
4+	36.	24.	16.	11.	95.	54.	36.	24.	31.	16.	11.	7.

SSN	6485.				9155.				10344.			
SSB	96108.				146684.				172519.			
TSN	40635.	25787.	116139.	76785.	45928.	28894.	112849.	74696.	48199.	29919.	183552.	122094.
TSB	335158.	426096.	834994.	644006.	404101.	490636.	842556.	645135.	437504.	507963.	1171730.	958844.

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	82197.	55071.	*	*	90578.	60708.	*	*	574441.	384907.
1	71595.	45257.	29521.	17653.	36542.	22919.	14746.	9033.	39933.	25210.	16594.	10281.
2	6574.	3533.	2180.	1157.	9669.	5915.	3578.	1671.	5209.	3009.	1784.	866.
3	491.	233.	140.	93.	568.	369.	200.	119.	758.	462.	286.	134.
4+	38.	23.	16.	10.	67.	45.	30.	20.	92.	62.	41.	28.

SSN	14263.				13959.				10052.			
SSB	216534.				264790.				178019.			
TSN	78698.	49047.	114054.	73985.	46846.	29248.	109133.	71551.	45992.	28743.	593146.	396216.
TSB	667583.	811936.	1168952.	790443.	495004.	565886.	896841.	649083.	429595.	507023.	2806490.	2590065.

Catch in numbers for fleet: 1

Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	421.	2520.	*	*	1.	2209.	*	*	6.	665.
1	3969.	1723.	5495.	4053.	2732.	2230.	5238.	3457.	2220.	840.	1373.	2932.
2	1224.	1165.	1485.	358.	1361.	1153.	1666.	727.	1337.	142.	777.	171.
3	14.	9.	16.	7.	142.	266.	8.	0.	188.	13.	19.	0.
4+	0.	2.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.
SOP	55271.	66017.	203874.	123781.	56228.	55972.	150783.	109843.	56337.	15205.	61263.	90213.

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.	5436.	*	*	8.	221.	*	*	24.	2947.
1	395.	180.	1186.	1687.	2665.	1073.	1585.	2138.	246.	82.	183.	632.
2	1066.	60.	245.	36.	398.	60.	165.	230.	699.	71.	250.	405.
3	72.	2.	6.	0.	12.	0.	0.	5.	20.	0.	0.	0.
4+	3.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.
SOP	37767.	5294.	45085.	86104.	33612.	15400.	37697.	60396.	22097.	3327.	15056.	60181.

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	7.	4721.	*	*	14.	986.	*	*	76.	2607.
1	1717.	693.	1097.	1945.	1657.	1782.	927.	1170.	1485.	419.	1010.	1030.
2	48.	146.	198.	90.	619.	567.	211.	125.	1335.	397.	67.	185.
3	7.	7.	0.	13.	24.	22.	8.	5.	93.	19.	1.	17.
4+	0.	0.	0.	0.	12.	0.	0.	0.	6.	0.	0.	0.
SOP	15272.	13838.	36211.	87352.	28283.	39730.	26158.	45253.	42621.	17791.	34774.	57894.

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4

Table 3.8.41 Continued

AGE												
0	*	*	34.	456.	*	*	11.	929.	*	*	186.	3794.
1	3340.	997.	2608.	2643.	1925.	754.	1040.	1033.	1902.	372.	1029.	1148.
2	1067.	230.	372.	254.	692.	472.	889.	442.	589.	285.	402.	134.
3	117.	20.	1.	2.	14.	58.	19.	2.	56.	29.	71.	0.
4+	3.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOP	61815.	19838.	85201.	87694.	35836.	28378.	58388.	50915.	33919.	15360.	50571.	75908.

Partial fishing mortality for fleet: 1

Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.003	0.030	*	*	0.000	0.052	*	*	0.000	0.021
1	0.046	0.031	0.162	0.216	0.051	0.066	0.269	0.362	0.082	0.050	0.133	0.575
2	0.119	0.197	0.519	0.297	0.130	0.192	0.587	0.760	0.296	0.058	0.622	0.363
3	0.163	0.186	0.732	1.265	0.233	1.128	0.144	0.000	0.657	0.112	0.295	0.000
4+	0.000	1.807	*	*	0.000	0.000	0.000	0.000	0.031	0.000	0.000	0.000
F (1- 2)	0.083	0.114	0.341	0.256	0.090	0.129	0.428	0.561	0.189	0.054	0.377	0.469

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.000	0.089	*	*	0.000	0.013	*	*	0.000	0.061
1	0.019	0.013	0.141	0.380	0.071	0.045	0.107	0.256	0.021	0.011	0.037	0.211
2	0.577	0.074	0.592	0.212	0.184	0.047	0.217	0.670	0.156	0.026	0.149	0.478
3	0.328	0.017	0.078	0.000	0.126	0.000	0.000	0.205	0.144	0.000	0.000	0.000
4+	0.110	0.000	0.000	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.298	0.043	0.367	0.296	0.127	0.046	0.162	0.463	0.089	0.019	0.093	0.344

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.000	0.089	*	*	0.000	0.019	*	*	0.001	0.029
1	0.056	0.036	0.089	0.279	0.050	0.086	0.073	0.152	0.044	0.019	0.071	0.119
2	0.027	0.134	0.338	0.324	0.169	0.288	0.208	0.228	0.325	0.191	0.055	0.263
3	0.017	0.024	0.000	0.111	0.169	0.288	0.208	0.228	0.335	0.133	0.017	0.337
4+	0.000	0.000	0.000	0.000	0.169	0.000	0.000	0.000	0.247	0.000	0.000	0.000
F (1- 2)	0.042	0.085	0.214	0.302	0.110	0.187	0.140	0.190	0.184	0.105	0.063	0.191

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.000	0.010	*	*	0.000	0.019	*	*	0.000	0.012
1	0.058	0.027	0.113	0.198	0.066	0.041	0.089	0.148	0.059	0.018	0.078	0.144
2	0.216	0.082	0.228	0.303	0.090	0.101	0.349	0.376	0.146	0.121	0.312	0.205
3	0.334	0.108	0.008	0.031	0.029	0.207	0.120	0.018	0.094	0.079	0.347	0.000
4+	0.106	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F (1- 2)	0.137	0.054	0.170	0.250	0.078	0.071	0.219	0.262	0.103	0.070	0.195	0.175

Log inverse catchabilities, fleet no: 1

Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.987	11.578	*	*	15.987	11.578	*	*	15.987	11.578
1	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489
2	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085
3	9.341	8.884	8.891	9.085	9.341	8.884	8.891	*	9.341	8.884	8.891	*

Table 3.8.4.1

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	11.578	*	*	15.987	11.578	*	*	15.987	11.578
1	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489
2	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085
3	9.341	8.884	8.891	*	9.341	*	*	9.085	9.341	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.987	11.578	*	*	15.987	11.578	*	*	15.987	11.578
1	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489
2	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085
3	9.341	8.884	*	9.085	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	15.987	11.578	*	*	15.987	11.578	*	*	15.987	11.578
1	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489	10.551	10.088	9.942	9.489
2	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085
3	9.341	8.884	8.891	9.085	9.341	8.884	8.891	9.085	9.341	8.884	8.891	*

Log inverse catchabilities, fleet no: 2

IYFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	2.855	*	*	*	2.855	*	*	*	2.855	*	*	*
2	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*
3	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	2.855	*	*	*	2.855	*	*	*	2.855	*	*	*
2	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*
3	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	2.855	*	*	*	2.855	*	*	*	2.855	*	*	*
2	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*
3	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	2.855	*	*	*	2.855	*	*	*	2.855	*	*	*
2	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*
3	1.812	*	*	*	1.812	*	*	*	1.812	*	*	*

Table 3.8.4.1 Continued

Log inverse catchabilities, fleet no: 3

EGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	5.778	*	*	*	5.778	*	*	*	5.778	*
1	*	*	3.714	*	*	*	3.714	*	*	*	3.714	*
2	*	*	2.685	*	*	*	2.685	*	*	*	2.685	*
3	*	*	2.685	*	*	*	2.685	*	*	*	2.685	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	5.778	*	*	*	5.778	*	*	*	5.778	*
1	*	*	3.714	*	*	*	3.714	*	*	*	3.714	*
2	*	*	2.685	*	*	*	2.685	*	*	*	2.685	*
3	*	*	2.685	*	*	*	*	*	*	*	2.685	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	5.778	*	*	*	5.778	*	*	*	5.778	*
1	*	*	3.714	*	*	*	3.714	*	*	*	3.714	*
2	*	*	2.685	*	*	*	2.685	*	*	*	2.685	*
3	*	*	2.685	*	*	*	2.685	*	*	*	2.685	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	5.778	*	*	*	5.778	*	*	*	5.778	*
1	*	*	3.714	*	*	*	3.714	*	*	*	3.714	*
2	*	*	2.685	*	*	*	2.685	*	*	*	2.685	*
3	*	*	2.685	*	*	*	2.685	*	*	*	*	*

Log inverse catchabilities, fleet no: 4

SGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	3.492	*	*	*	3.492	*	*	*	3.492	*
2	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*
3	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	3.492	*	*	*	3.492	*	*	*	3.492	*
2	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*
3	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	3.492	*	*	*	3.492	*	*	*	3.492	*
2	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*
3	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*

Table 3.8.4.1 Continued

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	3.492	*	*	*	3.492	*	*	*	3.492	*
2	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*
3	*	*	2.749	*	*	*	2.749	*	*	*	2.749	*

Log residual stocknr. (nhat/n), fleet no: 1

Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.644	-0.253	*	*	-3.676	0.140	*	*	-0.712	-0.462
1	-0.385	-0.785	-0.518	-0.381	-0.207	0.076	0.054	0.000	0.220	0.628	0.185	0.740
2	-0.653	-0.149	-0.407	-0.463	-0.485	-0.058	-0.216	0.339	0.287	-0.434	0.679	-0.123
3	-0.340	-0.206	-0.063	0.985	0.099	1.713	-1.623	*	1.085	0.232	-0.066	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	0.449	*	*	0.557	-0.536	*	*	1.649	0.920
1	-1.593	-0.736	0.272	-0.192	0.522	0.677	0.377	0.387	-0.421	0.609	0.346	0.073
2	0.591	-0.236	0.656	-1.182	0.262	-0.491	0.032	0.943	0.360	0.299	0.698	0.485
3	0.026	-1.718	-1.369	*	-0.115	*	*	-0.242	0.281	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-1.205	0.943	*	*	0.037	-0.049	*	*	1.162	0.264
1	1.105	0.448	-0.269	-0.006	0.405	-0.065	0.037	-0.049	-0.071	-0.616	-0.039	-0.417
2	-0.823	0.572	0.014	-0.260	0.405	-0.065	0.037	-0.049	0.725	0.485	-1.355	-0.030
3	-1.307	-1.152	*	-1.336	0.405	-0.065	0.037	-0.049	0.754	0.127	-2.549	0.220

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.635	-0.828	*	*	-0.780	-0.171	*	*	0.689	-0.418
1	-0.155	0.349	0.013	0.059	0.281	-0.166	-0.392	-0.192	0.301	-0.419	-0.067	-0.022
2	-0.051	0.253	-0.332	0.080	-0.612	-0.457	-0.076	0.335	-0.007	0.280	0.271	-0.075
3	0.382	0.530	-3.683	-2.185	-1.739	0.258	-1.146	-2.710	-0.450	-0.153	0.375	*

Log residual stocknr. (nhat/n), fleet no: 2

IYFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	-0.749	*	*	*	0.242	*	*	*	0.308	*	*	*
2	-0.930	*	*	*	-0.759	*	*	*	0.657	*	*	*
3	-0.445	*	*	*	-0.541	*	*	*	0.419	*	*	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.553	*	*	*	0.336	*	*	*	-1.655	*	*	*
2	0.241	*	*	*	0.282	*	*	*	0.038	*	*	*
3	-0.445	*	*	*	1.430	*	*	*	-0.535	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.169	*	*	*	-0.362	*	*	*	0.244	*	*	*
2	-0.094	*	*	*	0.256	*	*	*	0.009	*	*	*
3	0.966	*	*	*	0.685	*	*	*	1.046	*	*	*

Table 3.8.4.1 Continued

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	0.436	*	*	*	0.465	*	*	*	0.012	*	*	*
2	0.113	*	*	*	0.749	*	*	*	-0.562	*	*	*
3	-0.554	*	*	*	1.234	*	*	*	-0.379	*	*	*

Log residual stocknr. (nhat/n), fleet no: 3

EGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.349	*	*	*	-0.236	*	*	*	-0.063	*
1	*	*	-0.467	*	*	*	0.752	*	*	*	0.173	*
2	*	*	-1.906	*	*	*	-0.734	*	*	*	-0.141	*
3	*	*	-0.399	*	*	*	-0.236	*	*	*	-0.786	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	-0.986	*	*	*	-3.706	*	*	*	-1.628	*
1	*	*	0.066	*	*	*	-0.862	*	*	*	-1.543	*
2	*	*	0.510	*	*	*	1.002	*	*	*	-1.213	*
3	*	*	1.235	*	*	*	*	*	*	*	-0.245	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.454	*	*	*	0.946	*	*	*	-0.043	*
1	*	*	0.154	*	*	*	-0.164	*	*	*	-0.763	*
2	*	*	1.344	*	*	*	-0.431	*	*	*	0.352	*
3	*	*	-0.900	*	*	*	1.210	*	*	*	-1.100	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	1.428	*	*	*	2.011	*	*	*	0.474	*
1	*	*	1.202	*	*	*	1.249	*	*	*	0.204	*
2	*	*	1.071	*	*	*	1.096	*	*	*	-0.949	*
3	*	*	1.811	*	*	*	1.157	*	*	*	*	*

Log residual stocknr. (nhat/n), fleet no: 4

SGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	-0.743	*	*	*	0.036	*	*	*	0.703	*
2	*	*	-0.699	*	*	*	-0.969	*	*	*	0.772	*
3	*	*	-0.335	*	*	*	0.808	*	*	*	0.194	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.418	*	*	*	-0.285	*	*	*	-1.385	*
2	*	*	0.712	*	*	*	-0.748	*	*	*	0.666	*
3	*	*	0.605	*	*	*	-0.935	*	*	*	0.106	*

Table 3.8.4.1 Continued

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.019	*	*	*	-0.634	*	*	*	0.529	*
2	*	*	-0.579	*	*	*	-0.242	*	*	*	-0.617	*
3	*	*	0.193	*	*	*	-0.230	*	*	*	0.062	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	0.890	*	*	*	0.489	*	*	*	-0.038	*
2	*	*	0.751	*	*	*	0.702	*	*	*	0.251	*
3	*	*	1.181	*	*	*	0.690	*	*	*	-0.777	*

Weighting factors for computing survivors:

Fleet no: 1

Commercial fishery

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.618	1.707	*	*	0.618	1.707	*	*	0.618	1.707
1	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035
2	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821
3	1.187	1.031	0.526	0.592	1.187	1.031	0.526	*	1.187	1.031	0.526	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	1.707	*	*	0.618	1.707	*	*	0.618	1.707
1	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035
2	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821
3	1.187	1.031	0.526	*	1.187	*	*	0.592	1.187	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.618	1.707	*	*	0.618	1.707	*	*	0.618	1.707
1	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035
2	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821
3	1.187	1.031	*	0.592	1.187	1.031	0.526	0.592	1.187	1.031	0.526	0.592

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.618	1.707	*	*	0.618	1.707	*	*	0.618	1.707
1	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035	1.453	1.755	3.407	3.035
2	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821	1.829	2.586	1.675	1.821
3	1.187	1.031	0.526	0.592	1.187	1.031	0.526	0.592	1.187	1.031	0.526	*

Weighting factors for computing survivors:

Fleet no: 2

IYFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	1.502	*	*	*	1.502	*	*	*	1.502	*	*	*
2	1.847	*	*	*	1.847	*	*	*	1.847	*	*	*
3	1.151	*	*	*	1.151	*	*	*	1.151	*	*	*

Table 3.8.4.1 Continued

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	1.502	*	*	*	1.502	*	*	*	1.502	*	*	*
2	1.847	*	*	*	1.847	*	*	*	1.847	*	*	*
3	1.151	*	*	*	1.151	*	*	*	1.151	*	*	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	1.502	*	*	*	1.502	*	*	*	1.502	*	*	*
2	1.847	*	*	*	1.847	*	*	*	1.847	*	*	*
3	1.151	*	*	*	1.151	*	*	*	1.151	*	*	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	1.502	*	*	*	1.502	*	*	*	1.502	*	*	*
2	1.847	*	*	*	1.847	*	*	*	1.847	*	*	*
3	1.151	*	*	*	1.151	*	*	*	1.151	*	*	*

Weighting factors for computing survivors:

Fleet no: 3

EGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.617	*	*	*	0.617	*	*	*	0.617	*
1	*	*	1.154	*	*	*	1.154	*	*	*	1.154	*
2	*	*	0.909	*	*	*	0.909	*	*	*	0.909	*
3	*	*	0.882	*	*	*	0.882	*	*	*	0.882	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.617	*	*	*	0.617	*	*	*	0.617	*
1	*	*	1.154	*	*	*	1.154	*	*	*	1.154	*
2	*	*	0.909	*	*	*	0.909	*	*	*	0.909	*
3	*	*	0.882	*	*	*	*	*	*	*	0.882	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.617	*	*	*	0.617	*	*	*	0.617	*
1	*	*	1.154	*	*	*	1.154	*	*	*	1.154	*
2	*	*	0.909	*	*	*	0.909	*	*	*	0.909	*
3	*	*	0.882	*	*	*	0.882	*	*	*	0.882	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	0.617	*	*	*	0.617	*	*	*	0.617	*
1	*	*	1.154	*	*	*	1.154	*	*	*	1.154	*
2	*	*	0.909	*	*	*	0.909	*	*	*	0.909	*
3	*	*	0.882	*	*	*	0.882	*	*	*	*	*

Table 3.8.4.1 Continued

Weighting factors for computing survivors:

Fleet no: 4

SGFS

Year	1983				1984				1985			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	1.434	*	*	*	1.434	*	*	*	1.434	*
2	*	*	1.367	*	*	*	1.367	*	*	*	1.367	*
3	*	*	1.482	*	*	*	1.482	*	*	*	1.482	*

Year	1986				1987				1988			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	1.434	*	*	*	1.434	*	*	*	1.434	*
2	*	*	1.367	*	*	*	1.367	*	*	*	1.367	*
3	*	*	1.482	*	*	*	1.482	*	*	*	1.482	*

Year	1989				1990				1991			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	1.434	*	*	*	1.434	*	*	*	1.434	*
2	*	*	1.367	*	*	*	1.367	*	*	*	1.367	*
3	*	*	1.482	*	*	*	1.482	*	*	*	1.482	*

Year	1992				1993				1994			
Season	1	2	3	4	1	2	3	4	1	2	3	4
AGE												
0	*	*	*	*	*	*	*	*	*	*	*	*
1	*	*	1.434	*	*	*	1.434	*	*	*	1.434	*
2	*	*	1.367	*	*	*	1.367	*	*	*	1.367	*
3	*	*	1.482	*	*	*	1.482	*	*	*	1.482	*

Table 3.8.4 2 Assessment Quality Control Diagrams
Norway pout in the North Sea

a) **Assessment Quality Control Diagram 1**

Average F(1-2,u)								
Date of assessment	Year							
	1987	1988	1989	1990	1991	1992	1993	1994
1989[1]	0.786	0.540						
1990[2]	0.621	1.018	0.904					
1991[3]								
1992[3]								
1993[4]	0.913	0.737	0.699	0.744	0.678	0.567		
1994[4]	0.714	0.497	0.622	0.609	0.547	0.565	0.474	
1995[4]	0.798	0.545	0.643	0.627	0.543	0.611	0.630	0.543

[1]Annual *ad hoc* tuning. [2]Quarterly *ad hoc* tuning. [3]No assessment. [4]Quarterly modif. XSA.

Remarks:

b) **Assessment Quality Control Diagram 2**

Recruitment (age 1) Unit: '000 million								
Date of assessment	Year class							
	1987	1988	1989	1990	1991	1992	1993	1994
1989	6.4	89.0						
1990	12.0	31.1	84.9					
1991								
1992.								
1993	13.5	36.1	35.7	41.6	94.1	57.6[1]		
1994	14.3	39.2	40.3	42.9	83.2	42.9		
1995	14.1	37.9	40.9	42.0	71.6	36.5	39.9	

[1]1992 year class estimated in predictive mode.

Remarks:

Table 3.8.4 2 (cont'd)

c) **Assessment Quality Control Diagram 3**

Spawning stock biomass ('000 t)										
Date of assessment	Year									
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1989	145		[1]	[1]						
1990	148	153	377	[1]	[1]					
1991					[1]	[1]				
1992						[1]	[1]			
1993	118	82	131	148	221	433[2]	[1]	[1]		
1994	160	103	154	173	228	322		[1]	[1]	
1995	146	96	147	173	217	265	178		[1]	[1]

[1]Forecast. [2]1993 SSB estimated in predictive mode.

Remarks:

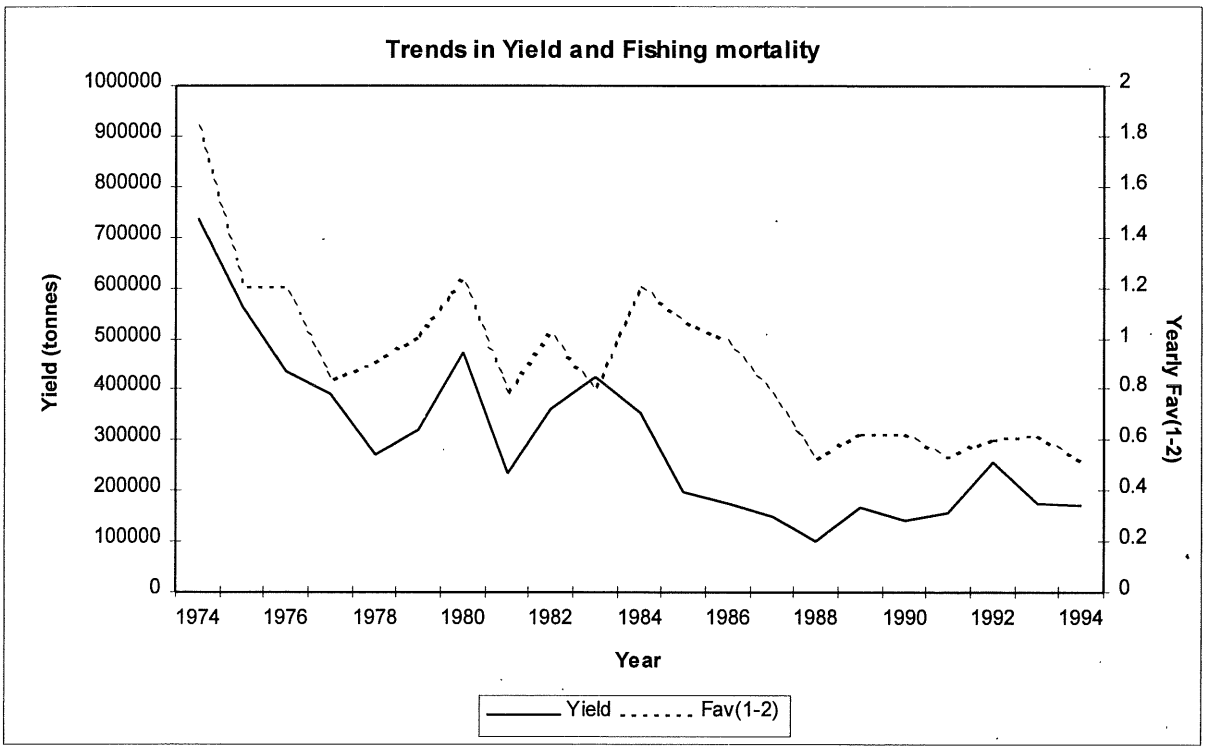
Table 3.8.6.1 **Trends in Yield, Average fishing mortality for 1- and 2-group, SSB and Recruitment.**

Year	Yield (tonnes)	$F_{av(1-2)}$	SSB (tonnes)	Recruitm. (millions)
1974	735800	1.84	171014	176064
1975	559700	1.206	208365	212259
1976	435400	1.204	199827	197659
1977	389900	0.835	242367	101987
1978	270100	0.907	240752	200901
1979	320200	1.006	197911	232819
1980	471100	1.233	332242	61114
1981	235700	0.777	277915	306115
1982	359700	1.016	173973	238371
1983	422900	0.795	372328	153788
1984	354900	1.203	376989	79640
1985	196500	1.071	181997	57202
1986	174400	0.99	95158	116234
1987	147200	0.782	104701	32348
1988	101600	0.526	150367	90706
1989	167100	0.627	98641	100086
1990	139500	0.623	149279	96446
1991	154600	0.536	174469	165882
1992	255100	0.6	219892	83887
1993	174000	0.615	269699	93127
1994	172100	0.521	183705	625036

NOTE: This table with data from a longer SXSA run will not be exactly equal to the shorter keyrun presented in table 3.8.4.1

Figure: 3.8.1.1 **Trends in Yield, Average fishing mortality for 1- and 2-group, SSB and Recruitment**

Norway pout in the North Sea



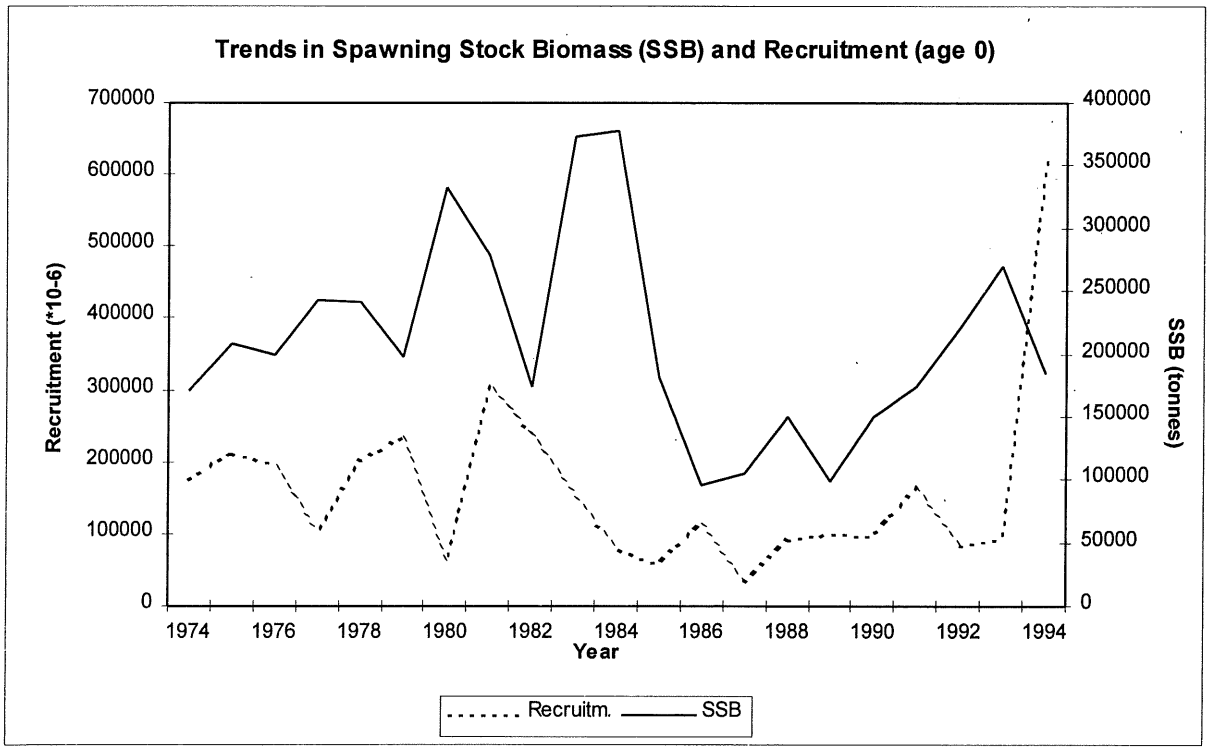
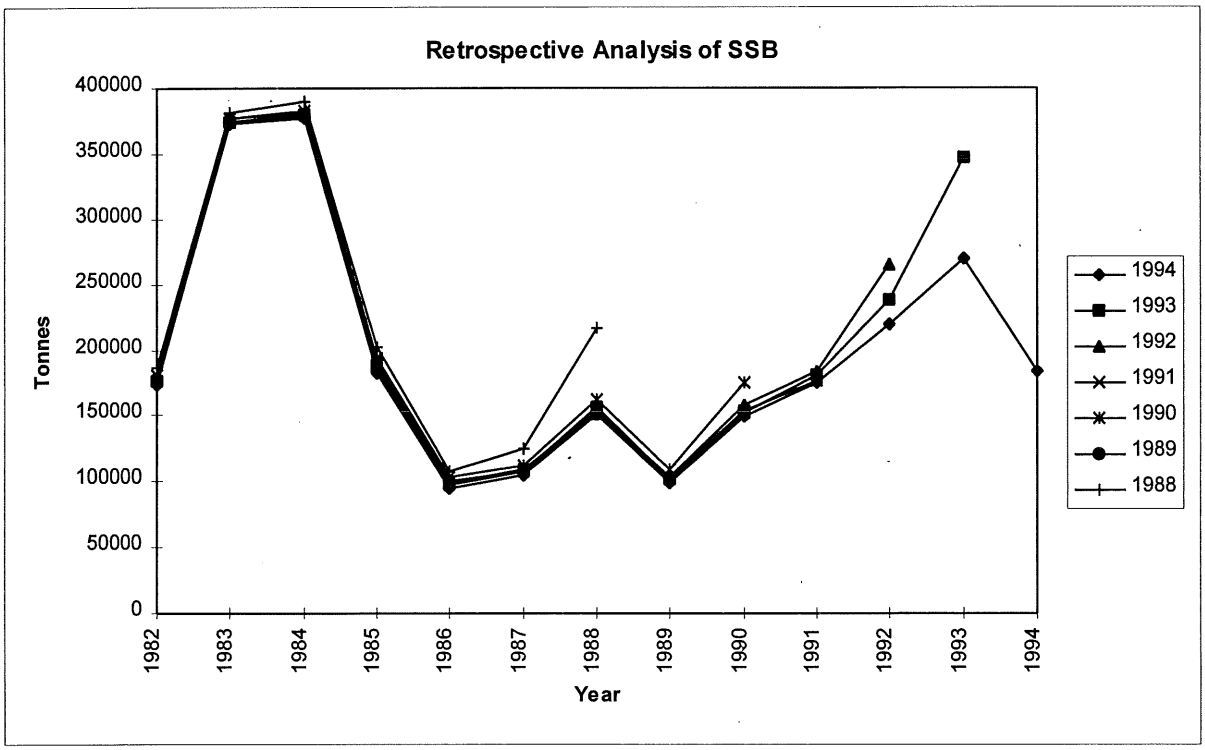


Figure: 3.8.2.1 Mean weight at age in stock

Norway pout in the North Sea

Figure: 3.8.4.1 Retrospective analysis of SSB and Recruitment

SXSA - Norway pout in the North Sea



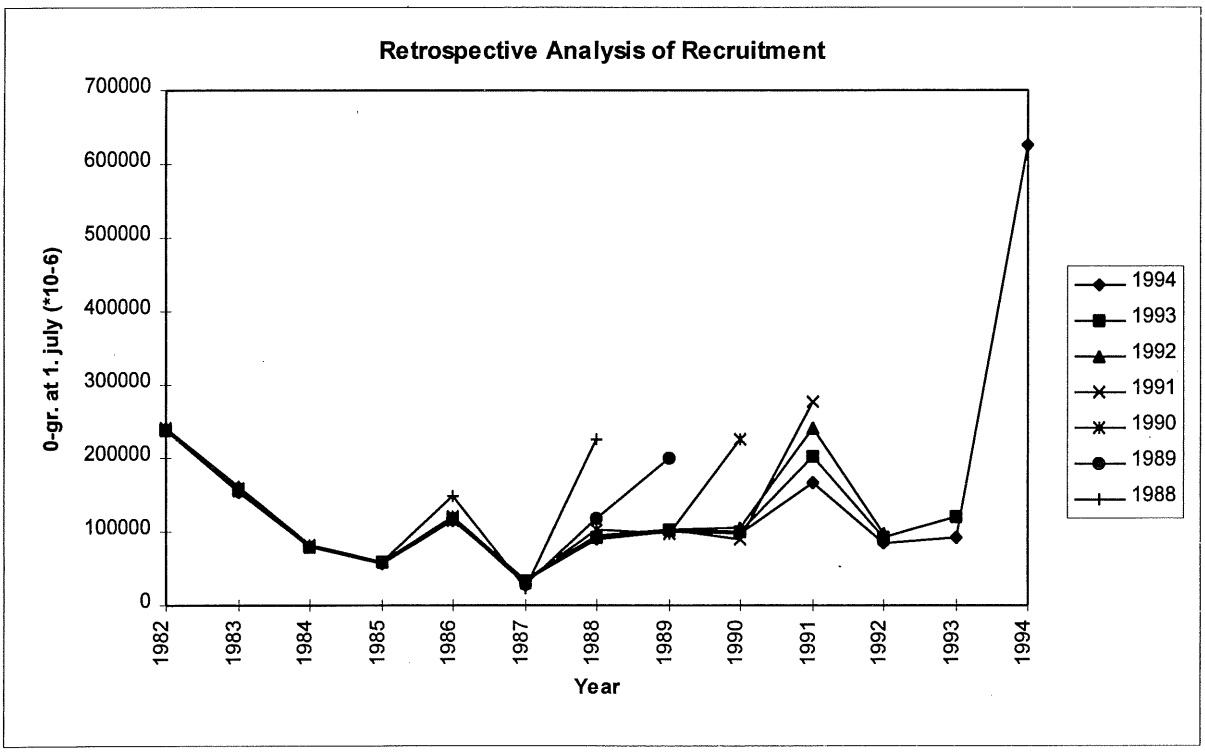
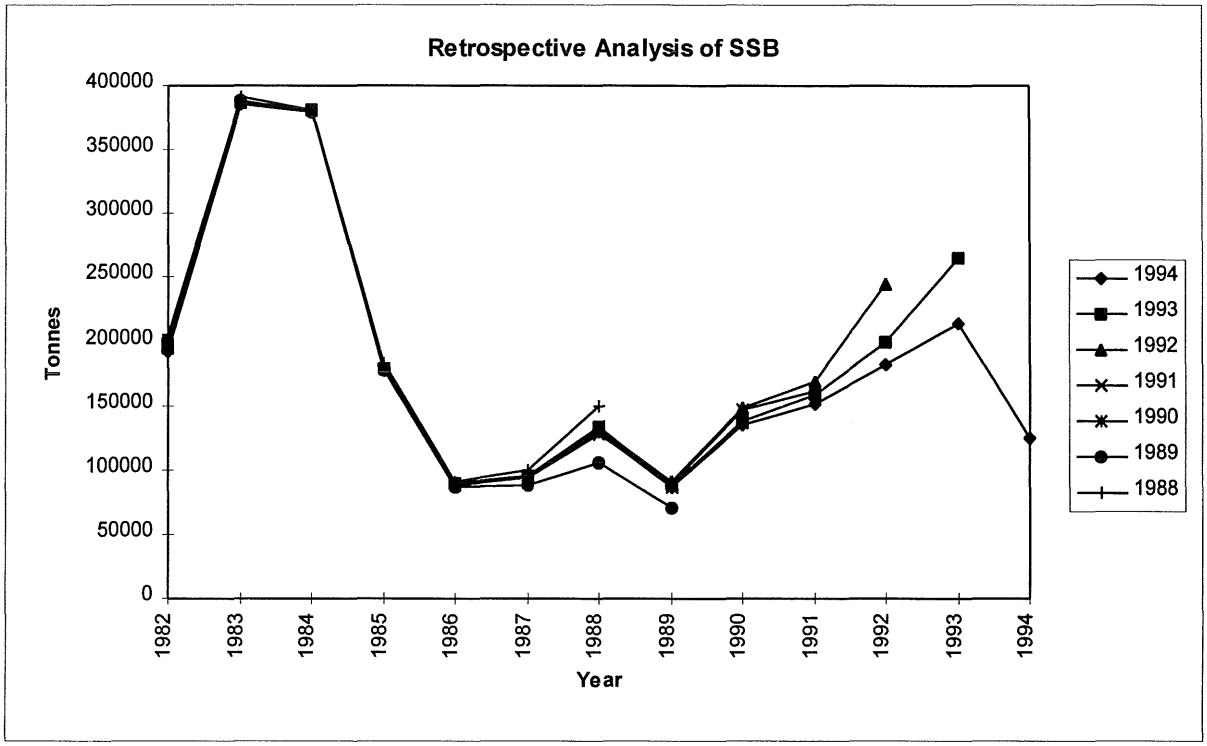


Figure: 3.8.4.2 Retrospective analysis of SSB and Recruitment

SXSA - Norway pout in the North Sea

Cosine filter applied to the estimation of the inverse catchability



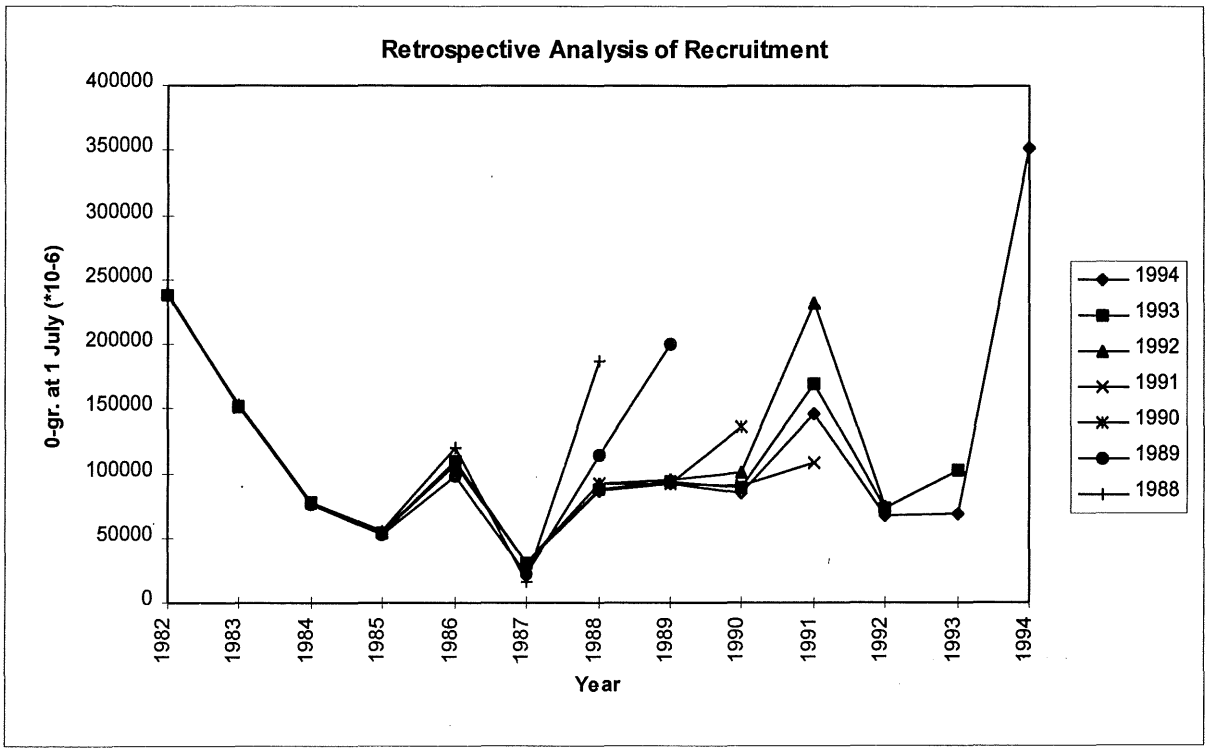
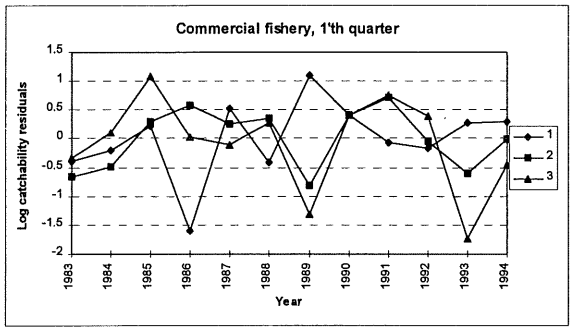
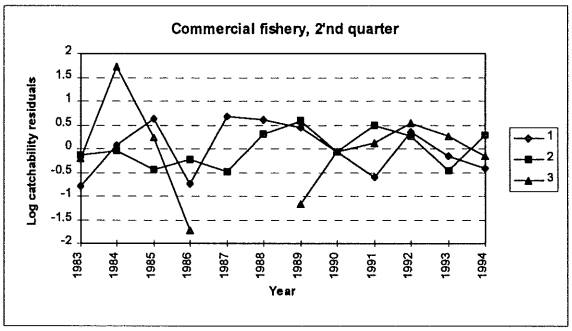
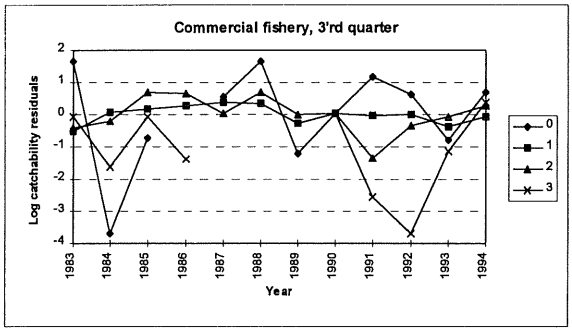


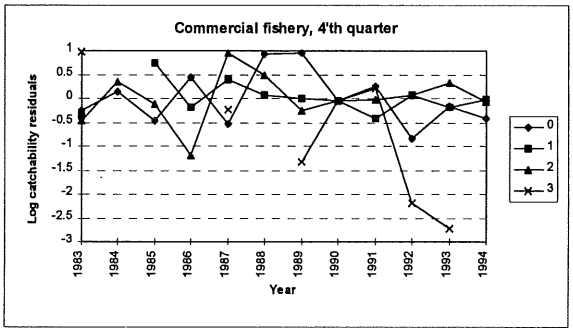
Figure: 3.8.4.3 Log catchability residuals by fleet and season

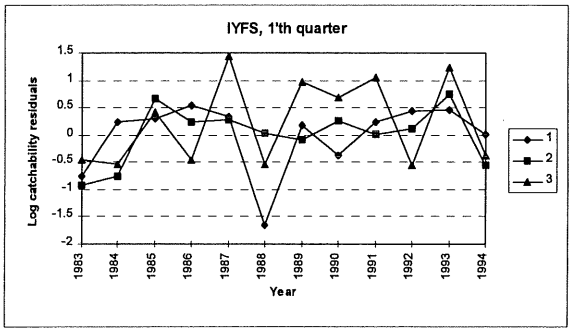
SXSA - Norway pout in the North Sea

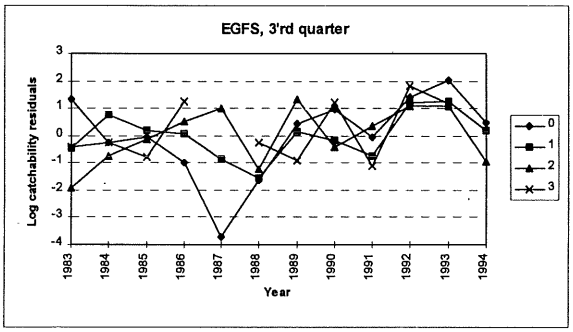












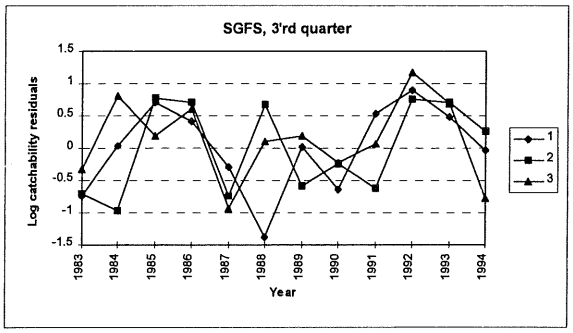
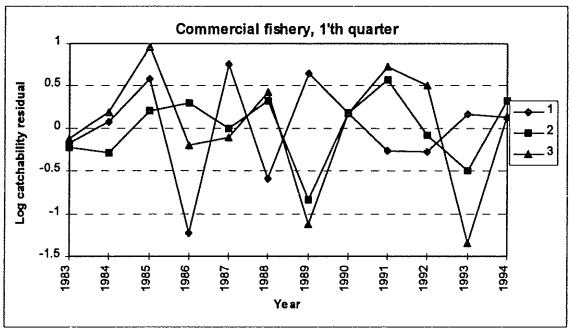
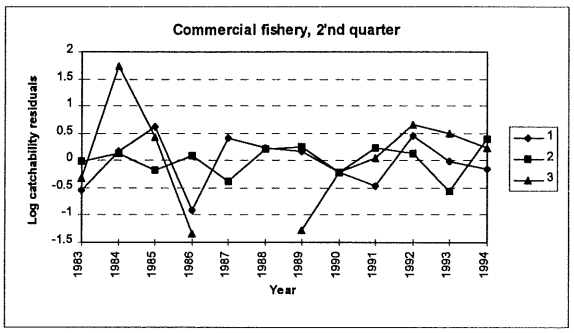


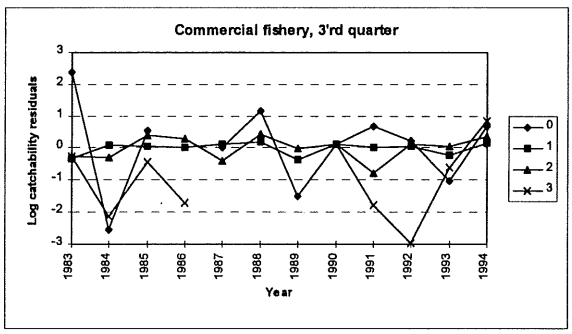
Figure: 3.8.4.4 Log catchability residuals by fleet and season

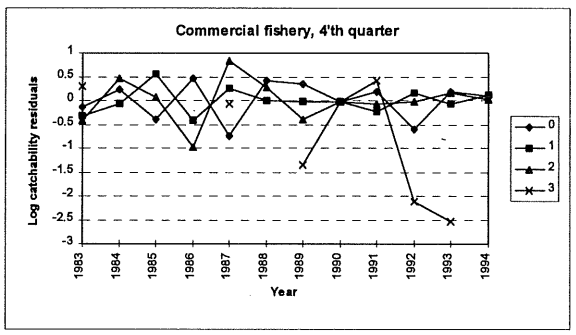
SXSA - Norway pout in the North Sea

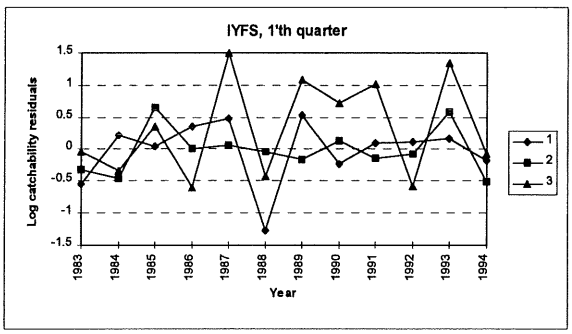
Cosine filter applied to the estimation of the inverse catchability

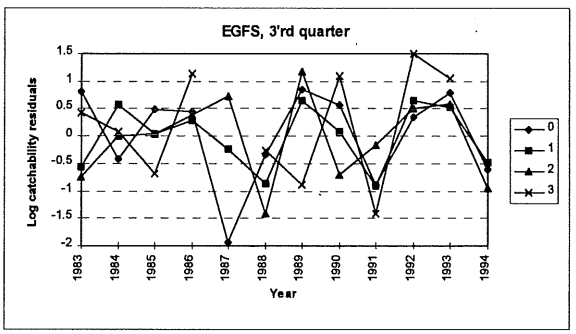












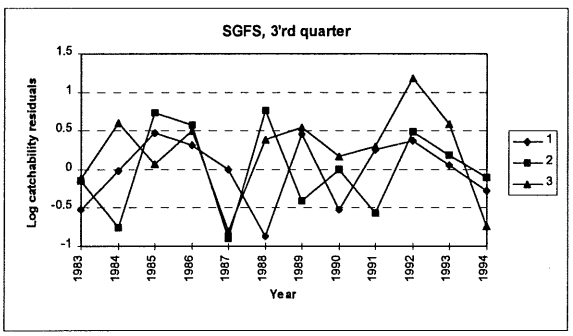


Figure: 3.8.7.1 Recruitment/SSB plot used to calculate F_{med} and F_{high}